(Inſcribed to the Britiſh LAND *and* SEA OFFICERS.*)*

THE

BRITISH MARS.

CONTAINING

Several SCHEMES and INVENTIONS,

To be Practiſed by LAND or SEA

Againſt the ENEMIES of GREAT-BRITAIN.

Shewing more plainly,

The great Advantage BRITAIN has over other Nations, by being MASTERS at SEA.

In TWO PARTS.

Part I. contains.

The Conſtruction of Boats both to ſtow in leſs room in Ships, and go ſwiftly, to diſcover an Enemy's Coaſt, and to land and embark Troops with greater Safety; alſo to conſtruct Veſſels to lye nearer the Shore, to better protect the Troops in landing or embarking; alſo rolling Defences to be uſed as floating Batteries, or as Floats for landing Cannon, &c. and for making Defences and Batteries on Shore more expeditiouſly, and for filling up Ditches, &c.

Alſo contains a Method to fit old Ships of War and ſmall floating Batteries, to batter land Defences with greater Force; and another Method to fit old Ships of War (that cannot be ſunk by Shot) to lye before Batteries and receive the Shot, while other Ships paſs by; with Remarks and Obſervations.

Part II. contains

Methods to fortify dwelling Houſes, that even Women and Children may defend themſelves from Indians with ſmall Arms, deſigned for our Settlements in America, and other Places.

Alſo a new Method of Fortification, and making Batteries.

TO WHICH IS ADDED, AN

APPENDIX,

Containing a Scheme for Manning the BRITISH NAVY, with leſs Grievance to the Subject;

And a Scheme to employ SEAMEN: Of a COPPER MINE near Hudſon's Bay: And of diſcovering the NORTH-WEST PASSAGE, or determine there is no ſuch Paſſage; with Cautions and Directions.

By JOSEPH ROBSON, ENGINEER.

The whole Illuſtrated by Eleven PLATES.

LONDON:

Printed for the Author; and Sold by *William Flexney*, near *Grays-Inn Gate, Holborn.* MDCCLXIII.

E R R A T A.

Page.	Line.	
106	16	*for* H. interior, *read* H. exterior.
107	22	— Fig. 2. *r.* Fig. 1.
104		In the laſt line of the N. B. *for* will that, *r.* that will.
123	34	*read* four, five, or ſix Feet deep.
125	33	*for* bend *r.* bond.
134	15	— or *r.* on.
149	24	— accure *r.* occur.
168	14	— wte *r.* twelve.
168	15	— ntenty *r.* twenty.
196	9	— 1 ft. 9 in. *r.* 1 ft. 7 in.

In the NOTES.

7	4	— cover the from the Enemy's view, *r.* cover the Enemy from the Boat's Fire.
13	9	— Sea *r.* Shore.
69	2	— Battle *r.* Batter.
85	12	— Muzzrling *r.* Muzzle Ring.
104	29	— ende *r.* render.

PREFACE.

WHILST England is bleſſed with a naval Force ſuperior to any Nation in the World; whilſt ſhe is bleſſed with every Material ſufficient to improve that Force; whilſt our naval Strength is the chief Defence of this Nation, and the only Means to humble the Pride and diſtreſs the Trade of our inveterate Enemies; and whilſt ſhe is bleſſed with a number of able and experienced Officers and Seamen, that have Courage and Reſolution to undertake any Scheme that the Government finds neceſſary to be executed for the Intereſt of this Kingdom, it is ſurely the Duty of every Well-wiſher to his Country to employ his leiſure Hours in Thoughts that may be uſeful, eſpecially in the Improvement of our naval Force, or on any other Means that may render Attacks at Sea or on the Enemy's Coaſt, more probable of ſucceeding, and with as little Riſque and Hazard as poſſible of the Lives of ſo many brave and uſeful Subjects.

It is from this Motive only, that I have ventured to ſet my Hand to Paper to ſhew a willingneſs at leaſt to contribute to the Public Good;

and as our Royal Navy ſeems yet a little deficient, I have more particularly adopted for my Plan the Conſtruction of ſundry uſeful Veſſels, as well as the Art of Fortification and Attacks by Sea and Land; which, tho' incorrect as it is, yet I am in great Hopes ſuch Improvement may be made upon it by our able and experienced Artiſts, as may anſwer in great Meaſure the End propoſed: And tho' every new Plan or Scheme may, at firſt View, ſeem difficult and impracticable to many People that are unacquainted with the Nature of it; yet I am fully perſuaded the ingenious Sort will find ſomething in the following Sheets that will be thought worth their Study and Obſervation.

As our Miſcarriages on the French Coaſt have been greatly owing to the want of a ſufficient Number of ſmall Craft and Boats, and that occaſioned chiefly for want of Room in the Ships to ſtow or carry more, I ſhall firſt treat of a reconnoitring Boat, and as ſuch on their Duty run great Riſque and require the greateſt Diſpatch, every Art or Contrivance (that is but of any Advantage to make her row or ſail the better) ought to be uſed. And then I ſhall treat of Boats to land or embark Troops on an Enemy's Coaſt. As ſuch Boats uſually made Uſe of have hitherto been found ſo inconvenient to ſtow on board Ships, that but few have been provided (from hence our Attempts have miſcarried, and many a brave Soldier and Seaman have loſt their Lives, for want of a ſufficient Number to take off all

all the Troops at once.) I have contrived for a better convenience of Stowage, that they be built in ſuch a Manner as to part in Halves, lengthways; ſo that as many of them may be carried in one Ship upon any Expedition, as will land all her Men at once: And however odd it may appear at firſt View by being built in Halves, an ingenious Carpenter or Boat-Builder, I am well perſuaded will ſoon render it practicable and eaſy.

I next proceed to treat of different Veſſels to cover the landing of Troops in ſhoal Water, and their Method of Defence for the better Security of their Men; and as the greateſt Part of it will conſiſt of wooden Rowls in different Sizes, which I make no Doubt will be laughed at, at firſt View, as well for the Oddity as the Expence, yet be aſſured, when they are duly conſidered, they will be found to be of excellent Service almoſt in every Action, not only by Way of Parapet, but will make exceeding good Floats to land Guns or Horſes, or any other great Weight or Lumber: Then after having given you a ſhort Deſcription of a ſcaling Ladder, and of a Bridge to croſs a Ditch; and referred to ſeveral practical Obſervations on landing Men; Defences when landed; and on the Security and Advancement of Troops in the Face of an Enemy. I then proceed to ſhow the Uſefulneſs of old Men of War, and a Method how to prepare and make them do good Service after they have been unfit for further Uſe in the common Way.

Then after treating of the Means Britain has to take the Enemy's Sea-Ports, and deſtroy their Shipping, I ſhall juſt give a ſhort Sketch of the Method that was deſigned for the better manning the Navy, which was not my own; but ſince Mr. *Hume's* and Mr. *Blake's* Plan, have appeared, it will be needleſs to enlarge further on that Head, ſo ſhall conclude with ſome Obſervations tending to ſhow the great Advantages Britain has, and may keep if ſhe pleaſes, over all the Powers of Europe.

It appears to me ſo very eaſy (in fine Weather) to lay Bodies in the Sea (which the Enemy from the greateſt Batteries cannot ſink; indeed a chance Shell may do Miſchief to ſome of ſuch Bodies, but the Uncertainty of Shells hitting a Ship is ſo great, that Shells in this Caſe need be little regarded) before Forts and Batteries, that will effectually prevent the Cannon on Shore from doing any conſiderable Damage to the Hulls of Ships which are running paſt, that I cannot but think it ſomething ſtrange that Britain has not attempted ſomething of this Kind to go into the French Harbours and deſtroy their Ships.

It ſeems to me very practicable that old Ships of War, as before mentioned (or other Bodies made on Purpoſe) may be laid before the Batteries at the Entrance of any Harbour, (or any Place I have ſeen) that Men of War may run into the Harbour under ſuch Cover, with Safety as to their Hulls.

The

The keeping a powerful Squadron before an Enemy's Port, is both dangerous and expenſive, eſpecially in Winter, and often doth not anſwer the End; for there are many Difficulties and Diſappointments attending a Fleet at Sea, whoſe Buſineſs is to keep near an Enemy's Coaſt: And Experience teaches that Ships may eſcape out of Port, notwithſtanding the greateſt Diligence in a Fleet at Sea to keep them in; I muſt acknowledge I cannot help being ſomewhat poſitive that Means may be uſed (by a Nation that is ſo greatly ſuperior at Sea as Britain is to France) to go into Breſt, or any Port in the World, and deſtroy the Ships there, at a much leſs Expence of Blood and Treaſure than the keeping Fleets at Sea to block up Ports.

It is evident that Britain (at preſent) has the Means to protect any thing upon the Sea; and can, in ſome Meaſure, block up the Enemy's Fleets in their Harbours; but by many Years Experience it is known, their Ships have often found Opportunities to ſlip to Sea, notwithſtanding a powerful Squadron imployed to block them up in the Port; and I think there are few Inſtances of our Fleet intercepting the Enemy's Fleet, particularly the Breſt Squadron.

If there was indeed a good Road where our Ships could lye ſafely all Weathers, at the Entrance of the Enemy's Harbours, they might keep them blocked up; but, except in fine

Weather

Weather, it is not practicable to reduce the blocking Ships up in a Harbour to any Certainty.

For if a Gale of Wind blow ſtrong upon the Shore, the Fleet at Sea that muſt not go for the Harbours, will ply to Windward: Nor can they be ſafe or eaſy till they have got a good Offing, perhaps ſeveral Leagues out of Sight of Land; upon which the Wind may alter ſo as to bring the blocked up Ships out of Harbour, and they may be at Sea three or four Days before the Ships that blocked them up can beat to Windward, and regain their Station off the Harbour's Mouth:

Or a Storm of Wind may blow the Ships from the Shore ſo far, that when the Storm is abated, the blocked up Ships may have an Opportunity to put to Sea without much Hazard of being intercepted, except met at Sea by Chance, as any other Ships may. A dark Night or a Fog may give the blocked up Ships an Opportunity to get to Sea unſeen. Beſides, our Admirals and Captains are Men, and may be overcome with continually being expoſed to Storms, &c. upon a dangerous Shore poſſeſſed by an Enemy.

I hope the riſquing our Ships, and the great Expence to keep ſo many Ships ſo long employed before the Ports of France, ſometimes to little or no Advantage, will plead Excuſe for my preſuming to give the few following Hints, where ſome Hope they may put Men of Capacity and

Power

Power upon thinking of new Ways and Means to accompliſh the great End in View (*i. e.*) to humble our Enemies, that they may not be able to diſturb the Repoſe of Europe, ſo much as they have hitherto done.

In the ſecond Place I have ſhown how to build dwelling Houſes, which Women and Children may defend againſt a conſiderable Party with ſmall Arms; which Sort of Houſes may be of great Security to our out Settlements in America, and for which Purpoſe they are chiefly deſigned.

In treating of Building defenſible Houſes, I have omitted to mention that in Countries where it Snows much, and the Wind blows the Snow in Quantities againſt the Sides of Houſes, Walls, &c. the defenſible Houſes in ſuch Countries muſt be built upon Pillars of Stone, Brick or Timber, ſecured as well as can be done from Fire with dead Sap, Plaiſtering, &c. if neither Stone nor Brick can be had; ſo that the Wind have a free Paſſage under the Houſe, that the Snow may not lye high againſt the Walls, and render the Houſe ſurpriſeable in at the Windows, high Doors, &c. It may be ſaid Indians may get under the Houſe and cut down the wooden Pillars, or make Fires to burn them; and if the Pillars are Stone or Brick, large Fires may be made under the Houſe, which will burn it down. I anſwer, there may be made Places to pour Water down upon the Fire, and Places of Defence

Defence (like cloſe Quarters in a Ship) that any one may be inſtantly killed that preſumes to come in under the Houſe; beſides Paliſadoes may be round the open Place under the Houſe, that a Man cannot get through between them, and yet be open to let Wind paſs ſufficient to blow away the Snow.

I was put upon this Sort of Fortification by reading the Account of a Man's Wife and Children being carried away by the Indians, and ſome of them cruelly murdered. An Abſtract of this Account is in the Appendix at the End of this Book.

I have deviated greatly from the common uſual Method of Fortification; being ſomewhat poſitive better Methods may be adopted. How far I have ſucceeded in my Search after better Methods of Fortification, the following Sheets will ſhow.

The Manner of Fortifying here propoſed is ſomewhat more expenſive to build than the Methods hitherto uſed; but that is more than balanced by theſe new Works being much ſtronger and defenſible with ſmaller Garriſons.

I have not given a Conſtruction, by Words at length, of the Methods of Fortification contained in the following Sheets; thinking it ſuperfluous, as the Plates are done by ſo large a Scale that every Part may be exactly meaſured; and as there

there are Profiles to every Plate (that cannot be well underſtood without them) the whole is eaſy to be underſtood.

That Fortification has not been much improved in many Years paſt, is owing, I think, to ſound Theory and Practice being ſeldom found in Perſons of ſuch Rank and Credit as are generally imployed to fortify Towns: And if ſome ingenious Man, by great Application in a low Station of Life, does ſometimes attain to ſound Theory along with Practice, he ſeldom has the Means to make his Abilities ſufficiently known to the World; for all the Endeavours a Man in low Circumſtances can make Uſe of, to get into a Station where he can make Uſe of ſuch Abilities as are here meant, are eaſily baffled by ſuperior judges.

What I have ſaid of Foundations and Walls, is deduced from the Practice and Experience of above Thirty Years, in almoſt all Kinds of Foundations and Walls, both in the Sea and on dry Land. It may ſeem to ſome Readers almoſt impracticable to conſtruct a Machine to lower Pieces of Maſonry of about forty Tons, which I have ſpoken of in treating of laying Foundations in the Sea: But in the firſt Place it ought to be conſidered that it is much eaſier to lower forty Tons, than to raiſe ſo great a Weight; and there cannot be ſo much Difficulty and Expence in making a Machine to lower Forty Tons, as would

would be requiſite to conſtruct a Machine to raiſe Forty Tons.

With Regard to Arches, I have only endeavoured to fix their ſeveral Thickneſſes or vertical Length of the Key or Arch Stones, in Proportion to their different Widths between their Springers.

At the End of this Book I have written a few Pages upon a Queſtion which has been much controverted (*i. e.*) Whether a large Receiver, ſuch as Jarrow's Lake in the River Tyne, up a River a Mile or two, more or leſs, from the Sea, doth or doth not cauſe the Water to come into that River with ſo much a greater Force than if the River was near of a Breadth all the Way to the End of the Flux as to cauſe the Water to raiſe higher ten or twelve Miles, more or leſs, up the River, than it would do if there was no ſuch Receiver as above; and by this Receiver not only holding a great Quantity of the Flux itſelf; but being alſo the Means of more Water being depoſited ten or twelve Miles up the River; I ſay if it is demonſtrable, a large Receiver near the Mouths of Rivers, has theſe Effects, the Receivers are in Fact the Cauſe of keeping the River's Mouths more open for Ships to ſail into and out of ſuch Rivers; and are alſo the Cauſe of the River's being navigable further up into the Country; and conſequently to leſſen ſuch Receivers muſt be injurious to the Navigation of Rivers.

THE

THE

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THE

THE BRITISH MARS.

CHAP. I.

Of the Conſtruction of reconnoitring Boats.

BOATS for this Service ſhould have much the ſame Length as a Man of War's twelve oar'd Barge; but ſhould be at leaſt a Foot broader, with a flatter Bottom, and of a very light built, ſo as to carry Ballaſt enough to make them bear a larger Sail than common, at a very ſmall Draught of Water. The Thickneſs of the Keel ſhould be ſuch as to admit of two Mortiſſes through it, from the upper to the under Side, the one forward, the other aft, each about the quarter of her Length from the Midſhips; but the forward one rather more ſo than the other. Theſe Openings to be each between three and four Feet long, and about an Inch and three quarters wide; and ſhould be continued as high as the Thwarts, by making a ſtrong Caſe, to contain a Plank or Lee board (well ſecured with Iron) to be let down or hawled up at pleaſure,

when the Boat is under Sail, in order to make her hold a good Wind.

In going about (when under Sail) the Lee-boards may be plucked up the Inſtant the Helm is put a Lee, and let down again as ſoon as the Boat begins to pay off.

As it is a principal Point that ſuch a Boat ſhould be conſtructed in the aptiſt Manner to row well in caſe of Purſuit, *&c.* The Thowles or Rullocks muſt be ſo placed, that the Purchaſe of the Oars may be taken at leaſt a Foot without the Gunnel, for by this Means the Oars may be longer, and give the Boat better Way with leſs Force.

Another Artifice for helping to make good Way, will be to form a Hole or two in her Stern, for letting through Poles of a convenient Length, with artificial Swan Feet at the outward Ends, to contract when hauled inward, and to expand when puſhed outward: by working theſe, as Occaſion may require, a conſiderable Degree of Velocity will be added to the Effect of the Oars.

And laſtly, it may be of ſome Advantage to raiſe a Standard in the after Part of the Boat, juſt clear of the Oars; to the Top of which is to be faſtened a Rope with a Hook at the lower End, on which may be readily hung a Weight of a Hundred or two, more or leſs, as may be found moſt convenient in practice; and a Butt being fixed about the Height of the Thwarts, let a Man in the Stern hawl aft the Weight, and at every Stroke of the Oars, let him take good Care to daſh it againſt the Butt, which will be found to quicken the Boat's Way.

N. B. It will be neceſſary to cover both the Butt and ſtriking Face of the Weight with ſome proper Material, for preventing too great a Jarr.

CHAP.

CHAP. II.

Of the Conſtruction of Boats for Landing or Embarking Troops on an Enemy's Coaſt.

SUCH Boats ſhould be about thirty Feet long, and near twelve Feet broad, and flat Bottomed, built with a Flooring of pretty thick Boards, ſo as to endure beating againſt the Shore, but as light as poſſible at Top, ſo as not to draw above eighteen Inches or two Feet Water at the moſt when loaded; both Ends ſhould be nearly a like, and a little rakeing. In the building they ought to be ſo contrived as to part in two, length ways, and be united again with little Trouble or Loſs of Time; the Execution of which muſt be left to the Builder's Diſcretion, the Intention thereof being for the Conveniency of Stowage on Shipboard. Thus by making three or four Sizes gradually diminiſhing, they may be ſtowed in little room on each Side the Ship's Quarters, (like *Hambrough* Boxes cut in two length ways) one within another, one half on one Side, the other half on the other, ſo that a Tranſport may carry as many as will land or imbark all her Soldiers at once*.

It will be eaſily apprehended that the Hooks fore and aft, the Floor Timbers, and the Thwarts, are not to be faſtened, but only ſayed, till the Boats come to be put together; yet in order to do this, every Piece muſt be bored off ready, and fitted with ſkrew Bolts and Nuts, inſtead of Nails and Treenails, with a Proviſion of tarred Canvaſs or Flannel, to ſlip between the two half Keels, Stern and Poſt,

* Being able to land all the Troops at once will be of great Service in many Reſpects, as will appear when Landing of Troops are treated of.

in order to make her Water tight upon being rejoined; I recommend both Ends to be formed alike, that either End may go foremoſt to prevent winding, either in going aſhore or coming off; the Thwarts ought to lie as low as poſſible, and the Rullocks to be placed fifteen or eighteen Inches without the Boat's Side, as in the reconnoitring Boats, under which long Poles or Sets may be carried, to help to puſh the Boats a head in ſhoal Water, when it blows too freſh for the Oars to do it.

Upon the End of the Boat which is to be next the Shore, or Enemy, there ought to be a Breaſt Work of two Feet thick, or more, conſiſting of light Materials, in the manner of a Pack or Roll quilted ſtrongly together, which, for the more convenient Stowage in the Bottom of the Boat when the Wind blows freſh a Head, may be made up in ſhort Lengths, with ſeveral Loops or Nooſes in each, to cord them faſt together when they are to come in uſe. This Breaſt Work, thus put together, and fixed in the Boat, will cover the Men from the Enemy's Fire, in advancing to, or retreating from the Shore. A more compleat Deſcription of theſe Packs or Rolls may be met with in Page 12.

For the common Defence of each Boat there ſhould be provided ten or twelve Muſkets, with large Barrels of well forged Iron, fit to carry a ſingle leaden Ball to a good Diſtance, or ſmall Grape Shot in caſe the Enemy be near. I prefer a leaden Bullet to an Iron one, on the following Account; one of lead of an Inch diameter being much heavier than an iron one of the ſame Dimentions will conſequently be driven with equal Force to a greater Diſtance.

The Muſkets, in order to diſtinguiſh them from others, may be called Artillery Muſkets; as each Boat will be near twelve Feet wide, five or ſix of the Muſkets being fitted, each with a Swivel ſharp pointed,

ed to ſlip readily into Holes made for that Purpoſe on the Top near the Inſide of the Breaſt Work, may be fired at once, whilſt the like Number are loading, to be ſlipt ſo readily into the Places of thoſe juſt diſcharged, that a conſtant Fire may be kept from every Boat, ſo as infallibly to annoy the Enemy, and keep them at a much greater Diſtance than can poſſibly be done by the common Muskets.

CHAP. III.

Of Veſſels proper to protect Troops whilſt Landing.

VESSELS of fifty-five or ſixty Feet long, and very broad, muſt be ſo contrived in their Conſtruction, that with a very little Draught of Water they may be able to keep the Sea in bad Weather; and ſerve as Tenders, *&c.* when not otherwiſe employed; but if the ingenious Ship-builder ſhould find himſelf at a Loſs to give a Veſſel theſe two Properties, though fitted with Lee-boards like the reconoitering Boats, the common Conſtruction may anſwer the End, by the Addition of a counter Bottom, conſiſting of four Parts or Quarters, and to be provided whilſt the Ship is building, occaſionally to fit and take off from the Veſſel's thin Parts, in the Nature of a Camel, forming a quite flat Bottom, like that of a Barge, when fitted on, to bring her to a ſmall Draught of Water. Such counter Bottoms may be brought under Veſſels, and faſtened to them with eaſe when the Water is tolerably ſmooth, after the following Manner; firſt hawl the Veſſel along ſide ſome Ship and lighten her as much as poſſible; then heave out the Quarters of the counter Bottom, and faſten them together two and two, with the ſtrong Chains fix'd ready for that Purpoſe; this being done,

ſink them*, till the Chains can paſs under the Keels of the Veſſels, either forward or aft, and hawl them to the proper Birth to which they were adapted, where faſten them with ſkrew Bolts or the like Contrivances for that Purpoſe, ſo that the Parts may meet and butt each other about the Midſhips, and be ſecured in that Poſition†.

It is neceſſary that ſuch a Veſſel ſhould have two Decks very well ſupported, and at leaſt five Feet and a half in height between Decks, that there may be convenient Room for Capſtanes between Decks, and more eſpecially for Oars to row in failure of Wind, and the better to keep her Head toward the Enemy, when within reach of their Shot.

As the Nature of the Service requires that theſe Veſſels ſhould be very ſtiff, and draw but very little Water when they have their Guns and Men aboard, it

* Theſe counter Bottoms may ſoon be cleared of Water, by means of a Tube about nine Inches or a Foot ſquare, and fifteen or twenty Feet long open at both Ends, made of Oak ar Fir Plank, about one Inch and half thick, with a convenient Number of Valves in the upper Side, (this ſort of Pump lying in an inclining Poſture when in uſe) with a light Frame of Braſs or Iron that fills the Tube, and has large Valves to fly open eaſily, when the Frame touches the Water. This Frame ſhould be faſtned to a Pole about two Feet longer than the Pump, and one or two Men working the Pole puſh the Frame to the Bottom of the Pump, the Valves open and let the Water continue in the Pump, as deep as the Pump is emerged, and as they attempt to hawl the Frame up the Valves ſhuts, and they hawl all the Water up that is in the Pump above the Valves.

I made ſome of theſe Pumps of ſuch a Size, that every Inch in Depth contained a Gallon; one of them being emerged eleven Feet, ſix Men made eight Strokes in a Minute, which drew up above four Tons of Water.

† Veſſels ordered after this Manner will endure a ſwell or gentle Summer Sea, and lye near the Shore with Cannon to annoy the Enemy and keep them at a Diſtance.

it will require a due Conſideration to conſtruct them; becauſe the Veſſels muſt be made able to carry their Cannon high, which may be ſix in Number, pointing forward, or aft; but as the Breadth of the Veſſel will not at the utmoſt admit of more than three large Cannon to point forwards, it will be neceſſary to plant them in two Tiers toward the Midſhips, at a proper Diſtance behind each other, and the fore Tier to be about four and a half or five Feet below the after Tier, that the after Cannon may fire clear of the fore ones.

For the better Security and Defence of the Men, ſtrong Parapets of Junk and other Materials may be provided, ready framed in ſhort Lengths for the better Conveniency of Stowage in the Hold when out of uſe, to be ready at any Time to be placed in their Births upon the Decks before the Guns, in a ſloping Poſition; whereby the Enemy's Balls, though ſhot from a higher Battery, will ſtrike the Parapet with only a ſmall angle of Incidence, without taking any conſiderable Hold of it, and conſequently will glance and be reflected upwards*.

Theſe Veſſels being to fight their Cannon lying with their Ends to the Shore, it may perhaps ſeem as a Matter of ſome Difficulty to keep them from caſting a thwart, butthis may be effectually prevented, by ſtrong Stakes ſhod with Iron, ſo contrived as to be let fall into the Ground on each Side the Veſſel cloſe aft, and to be taken up again at Pleaſure, through Holes wrought

* The higher a Veſſel carries her Guns. the greater Advantage has ſhe in annoying the Enemy's Troops, as ſhe has a better Command of riſing Beaches, which frequently at low Water cover the Boats from the Enemy's View. And if the Water is ſmooth where the Troops are deſigned to be landed, ſuch Veſſels may be of excellent Service, by two or three of them being faſtened together, as ſhall be explained in the next Chapter.

wrought in her Bottom for that Purpoſe when building, on each Side near the Veſſel's Quarters, and as far aft as can be *.

CHAP. IV.

Of joining three Veſſels together, to be of ſufficient Force for carrying large Cannon, both to annoy the Enemy and protect Troops in landing or embarking, when the Water is ſmooth and ſhallow, as mentioned in the laſt Chapter.

THE ingenious Shipwright is here again to be informed, that a third Property will be requiſite in the Veſſels treated of in the forgoing Chapter, in order to make them anſwer our further Purpoſes; namely, that they be formed ſtrait or Wall ſided, in order to lye cloſe along ſide each other, when two or three of them are faſtned together; but as I am ſomewhat ſuſpicious that it will be ſcarce practicable to conſtruct Bodies which will anſwer all theſe ſeveral Ends thoroughly, I ſhould rather adviſe, conſidering that the Expence will be trifling, when compared with the great Advantages reſulting from them, that Veſſels be built on purpoſe, of about the ſame Dimenſions as thoſe laſt treated of: for example, ſixty Feet

* It may be preſumed that it will ſeldom be attempted to land Troops in a Sea that will not admit of Boats full of Men to go aſhore with Safety; in a moderate Sea the riſing of the Veſſel will not lift the Stakes out of the Ground, but the Veſſel will ſlip up and down the Stakes by the Action of the Swell, and an Anchor out to Sea will ſecure her from thwarting. If on the ebb Tide the Veſſel be in danger of grounding, the Stakes may eaſily be hove out of the Ground by the Capſtans and Pulleys fixed between Decks, and when ſhe is hawled into deeper Water, the Stakes may be let down in a Moment.

Feet long by twenty broad, the ſame Height between Decks, with Row-Ports, with counter Bottoms to make the Bottom flat, and a ſtraight upright Side, eſpecially from the light Water Mark; the Ends fore and aft ſomewhat like the Society's Herring Buſſes, and to be rigg'd with a light Maſt, ſomething after their Manner, or any other that ſhall be judg'd moſt convenient to put in or take out at pleaſure: Each of theſe Veſſels ought to have ſix ſquare Openings on each Side, nearly at equal Diſtances, a very little above the light Water Mark, and ſix more like Openings cloſe below the upper Deck Beams, with Trunks to the low Openings, made tight to run from Side to Side, and firmly ſecured, ſo as to be fit to receive ſtrong Beams of Timber that ſhall run thro' the two or three Veſſels to faſten them ſecurely together, for the Uſe and Purpoſes hereafter mentioned.

In order to put theſe Veſſels together, in the firſt Place, if three are to be put together, let the middle one receive two of the aforeſaid Beams, through the forward and the aft Openings, and next let the other two Veſſels receive the Ends of the Beams, each in at their Sides; theſe two alone will be ſufficient to keep the three Veſſels in equal Motion, and to facilitate the Introduction of the reſt of the Beams; after they are all fix'd right in their Places, unrigg and take out the Maſts, Sails, *&c.* of the two outſide Veſſels, leaving the middle one rigged, that ſome Sail may be uſed if Wind offers. Faſten them altogether with Chains acroſs their Bottoms fixed for that Purpoſe; thus they will be able to carry the heavieſt Cannon on their upper Decks, eight or ten Feet high above the Water; and in caſe the Water be quite ſmooth where the Veſſels are to be employed, a higher commanding Battery may be raiſed above the

the former*, ſuppoſing ſuch to be at hand in the Veſſel, ready framed to be put up and taken down at pleaſure; inſtead of a Parrapet upon theſe commanding Batteries, place ſmall upright iron Stantions ſix Feet long, upon which hang a Quilt of woolen Rags, or other Matter, Muſket proof, with ſmall Pieces to lift up and form Openings for the Cannon to fire through, and fall down again to ſtop Muſket Shot from the Enemy whilſt the Cannon are re-loading; the importance of theſe ſorts of Batteries will better appear when we come to explain the Manner of Landing†.

CHAP. V.

Of divers Inventions; and firſt of rolling Breaſt-Works, to ſerve as Parapets, &c.

THE rowling Breaſt-Works here propoſed, may be made of any ſort of Materials proper to reſiſt or deaden the Motion of Shot; ſuch as old Quilts, Raggs, or woollen Cloths of any kind that will come cheap, which may be, for the better Convenience of folding together, wrought up into Plat or Cordage; take a Balk of Timber of the Length of each Parapet,

* Theſe commanding Batteries, in ſmooth Water, will be of great Utility, as they will have a great Command over the Enemy's Situation and Works aſhore.

† Two or three of theſe Veſſels being fixed together, it may be eaſily tried how high they will carry a Battery of any Number of Guns of given Sizes, by raiſing ſeveral ſtrong Sheers on the Decks, and heaving the Weight of the Platform, Guns, *&c.* up a conſiderable Height, making Trial at ſeveral Heights, after every Thing is well faſtned, and then by Means of Ropes at the Top of the Sheers giving the Veſſels the like Motion as in a moderate Sea: This ſhould be done before the commanding Batteries are framed.

pet, at the Ends of which fix ſtrong iron Gudgeons to receive a Frame convenient for the Men to convey it, either to hawl it after, or puſh it before them; this Frame may have Spikes ſo hung to it as by their Ends trailing upon the Ground to hinder its running backwards, when puſhed or hawled up Hill, or its recoiling when ſtruck by Shot; at each End of the Timber Balk or Beam, fix Spoaks of Iron, like thoſe of a Wheel, to keep the Wrapping regular; then fold the woollen Rope or Plat round the Balk (which ſhould be ſtraight for rolling Parrapets, but crooked and ſmall for thoſe at the Bows of Boats) taking Care to fix Skewers of Wood or Iron in many Places of the Roll, to keep the Wrapping well together, which for further Security, may be at laſt covered with a ſtrong Netting of hempen Rope.

Rolling Breaſt-Works of different Forms and Sizes, thus compacted, will anſwer the different Purpoſes of ſtuff'd Gabions, Corbels, Faſcines, Earth-Bags, Mantlets, or any other Contrivances for covering the Men from the Enemy's Fire in attacking Fortreſſes; as will better appear hereafter. They will alſo, with the help of a light Covering of Tarpaulin, Leather, or other durable Materials, make excellent Rafts, to carry and land any heavy Weight, as Cannon, &c. and may be rendered very fit, if due Care be had to the Covering, for erecting floating Batteries upon them; for if they be kept dry, and not very hard worked, they will ſwim more than half the Diameter above Water; but great Care muſt be taken not to let them get thoroughly wet, becauſe then they will only float by the upper Surface, and if twiſted or made very ſolid, will reſiſt Cannon Ball better than any other Materials I know of that will ſwim.

A ſhort Account of the Uſe of theſe rolling Breaſt Works.

SUPPOSE a Debarkation intended at a good and advantageous Landing-place, but where great Oppoſition is expected, the Enemy having Cannon planted on Batteries, and Works thrown up, not only near the Shore to hinder the Landing, but alſo at a proper Diſtance has formed Redoubts, with other Batteries, and a Line of Communication, ſo that Cannon Shot from a Frigate or other ſmall Veſſel, lying at a common Diſtance from the Shore, can do them but little Harm; Now though the Enemy's Cannon cannot reach the Frigate, no more than the Frigate's Guns can reach them, yet the Enemy's Guns may eaſily reach the Water Side with ſufficient Force to annoy the Troops, both in landing and when landed. Indeed, if ſuch a Diſpoſition be made by the Enemy, and they perform their Duty well, it is impractible to land, according to the common Method, without conſiderable Loſs. But ſuppoſing rolling Breaſt-Works provided, twenty Feet in length, and ſix Feet in diameter, as before deſcribed; Rafts may be made of them by faſtening five of them together to every Raft, which Rafts will conſequently be thirty Feet long and twenty broad.

Acroſs the five Rolls ſo laſhed together, lay ſtrong Planks, thirty Feet long, to make them bear alike in the Water, with other Planks twenty Feet long, and two or three Inches thick, acroſs theſe; thus there will be formed a good Platform for Cannon to reſt or recoil upon, ſhould there be Occaſion for firing from the Raft; ſome of theſe upper Planks ſhould have Irons fixed near their Ends, fitted to receive and hold faſt other Rolls of ſix Feet diameter, to ſerve for a Parapet to cover the Men from the Enemy's

Enemy's Fire, whilſt Landing, or firing their own Cannon *.

Being furniſhed with a ſufficient Number of theſe Rafts, any Body of Troops may approach the Shore under a good Defence; having at all Events a ſufficient Number of Cannon to anſwer thoſe of the Enemy; but ſhould there be no Need of firing the Cannon at Sea, the Rafts may be puſhed aſhore about high Water, or upon the Ebb †, and when the Fore-part is laid a-ground, ſufficient Planks muſt be laid from the Rafts to the Shore, and the Parrapet Rolls rolled off firſt, and plac'd in proper order on the Shore or Beach, and the Cannon landed next and brought up to the Parrapets, all which may be ſo quickly diſpatched, ſuppoſing the Water ſmooth, that in about half an Hour, from many ſuch Rafts, an Hundred Cannon may be landed and made ready for Action, covered with the rolling Breaſt-Works, under which the Troops may advance in tolerable Safety, to attack any Place or Enemy, with as many Cannon as may be judg'd proper, whereby ſuch Advantages may be gained as will reaſonably aſſure Succeſs with very little Loſs.

If a great mrny Cannon ſhould be wanted aſhore, each Raft will be able to carry four ready mounted, beſides

* Rolls of ſix Feet diameter, and not too hard work'd, will float near three Feet and a half out of Water before any Thing is laid upon them, and twenty Tons will ſink them about twenty-three Inches more; wherefore each Raft will carry about twenty Tons, and at the ſame Time bear the mounting a Battery of two Guns in front, in ſmooth Water, or when there is only a moderate Swell.

† The Re-action of the Sea will prevent their taking the Ground where the Sea has a conſiderable Declevity, therefore ſtrong Ponies like them uſed to cramp and manage Weſt Country Barges upon the *Thames*, muſt be ready upon the Rafts to confine them to the Shore.

beſides the two for immediate Service; and the Raft being taken aſunder, and landed, will be reſolved into four rolling Breaſt-Works or Merlons, for the four Cannon, beſides the two that were ready for Action upon the Raft. Thus each Raft will be able to land ſix Guns, with all their Equipage, which when on Shore will make a Battery of ſix Guns, with all requiſite for Service in a very little Time; ſo that ten Rafts will furniſh Batteries for ſixty Pieces of Cannon, and carry many other Neceſſaries aſhore beſides; one Raft alone would carry the Weight of ten, but would furniſh Materials for no more than ſix; and if it is apprehended that the Cannon on the Rafts will be much uſed in firing againſt the Enemy, it will be proper to have two or three other Rafts to carry the Cannon, *&c.* on Shore, for Shore Service.

By theſe Helps, and a proper Uſe made of theſe Veſſels as before directed, Troops may land at any Place in fine Weather, and even have the Advantage of the Enemy, though ſuperior in Number; for theſe Rolls will form into Batteries ſo very expeditiouſly, that an Army of three or four Thouſand Men, once landed, may advance with fifty Cannon in Order of Battery a Mile or two, in five or ſix Hours from landing, the Rolls ſufficiently covering their Front, ſo that they will never be at a Loſs to fight their Cannon under Cover, ſhould they be ſuddenly attacked on their Way by the Enemy.

High Batteries may alſo be raiſed in a very ſhort Time, by ſetting a Number of large Rolls on End, and binding their upper Ends together with Ropes provided

* I make no Mention of Horſes, becauſe all or moſt of theſe Rolls will be too cumberſome to be drawn by them from Place to Place to any great Diſtance, they being chiefly adapted to Coaſt Fighting (where Shipping can carry them near to the place of Action) where many Horſes for that Uſe would be inconvenient.

provided for the Purpoſe, throwing up Earth againſt their lower Ends to make them ſtand the faſter; at the ſame Time ſhorter Rolls of ſix or ſeven Feet Diameter ſhould be ready for a Parapet or Merlon, between every two Guns, with flat Pieces to form the Embraſure, and fill them to the Top if needful.

To make the Platform for working the Cannon upon in Time of Action, lay three Inch Planks, not very cloſe to one another, the whole Length of the Batteries, and cover them with others about ſeventeen or eighteen Feet long, laid acroſs cloſe to each other, and then the Cannon will recoil and traverſe eaſily over them.

Of the practical Conſtruction of theſe high Batteries.

HAVING fixed upon the Spot of Ground, roll a ſufficient Number of Breaſt-Works between it and the Enemy's Fire, to prevent their Shot from annoying the Men while at work; make the Ground plain, and, if it can be effected with a little Labour, let it lower away gently towards the Object that is to be battered, that the Top, on which the Cannon is to recoil, may have a Deſcent towards the Embraſures; then ſet a Number of Rolls on their Ends, to form a Rampart about twenty-eight Feet broad, upon the Top, for which four Rolls of ſeven Feet Diameter, ſet on a Row, will ſuffice; the Length muſt be ſuited to the Number of Cannon intended to be planted upon it; allowing about ſixteen or ſeventeen Feet of Length, to each twenty-four Pounder.

Now as the Parapet is to be made of Rolls, it will be neceſſary that the Rampart ſhould be hallowed along the Front, to cauſe it to lie firm upon it; and this may be effected by making one Side of each of the outſide Rolls that are to make the Rampart,

a Foot ſhorter than the other; for if the two ſhorteſt Sides be placed parallel to each other, and next the Front, a Hollow will be thereby formed in the Rampart, ſo as to make it hold the Parapet Roll faſt.

After the upper Ends of the Rampart Rolls are laſhed firmly together, a good Quantity of Earth muſt be thrown up againſt their Bottoms, to make them ſtand faſt, and then the Parapet Rolls muſt be rolled up and properly placed, having about twenty Inches Opening between each two Rolls for an Embraſure, and fitting in the Madriers at the ſame Time to prevent the Enemy's Shot from paſſing through the Embraſures. The Madriers is ſo well known as not to need any particular Explanation*.

When all Things are in readineſs for laying the Platforms, begin with laying three Inch Planks ſtretching along the Rampart made of Rolls, whoſe Ends muſt butt or meet in different Places upon the Rampart; then lay other Planks, two Inches thick and eighteen Feet long, acroſs thoſe already laid, for the Guns to recoil upon.

Another ſingular Uſe of Rolls will be to roll along before Cannon that are advancing to cover or form an Attack; for it is eaſy to conceive that by the Means of ſuch rolling Breaſt-Works, any Number of them may be puſhed forwards under ſufficient Cover as near an Enemy's Fortification as is neceſſary.

When a Breach is not intended to be made, ſix or nine Pounders, mounted on travelling Gun Carriages, will be ſufficient, with rolling Breaſt-Works well ſoaked in Water between each Cannon, and a ſquare

* The Ends of the Rolls which are to form the Parapet, ought to be beveling, in order to make the Embraſure wideſt on the Side next the Object intended to be battered.

ſquare Madrier of the ſame Materials to fill as high as the Cannon, the Space between the rolling Breaſt-Works in time of Action; on a March the Madriers are to be hung to the fore part of the Guns, to ſecure the Carriage from the Enemy's Fire, upon which other Madriers are to be laid to fill the Openings between the Breaſt-Works to the Top when needful, thus during the Advancing of the Cannon, the Men who work them will be covered with a good Breaſt-Work.

When the Cannon are to be conducted a greater Diſtance, they may be fitted in the Manner following: If there is any Apprehenſion of meeting an Enemy in the Field; let Iron be fixed to the Axle-tree of the Carriage, of Strength ſufficient to ſupport an Iron Bar of twenty Feet in length, lying acroſs, a little before the Muzzle of the Gun, and about ſix Feet in height from the Ground, on which to hang a Mantlet, Muſket proof, with a ſmall Piece of Mantlet to cover the Mouth of the Gun, which may be put aſide when it is to be fired; the Mantlet extending about eight Feet on each ſide the Carriage, will cover the Men that puſh the Cannon forwards, as well as the Muſqueteers that march with the Cannon. The Cannon, when marching in the Face of an Enemy, muſt be puſhed forwards by means of Trails upon ſmall Wheels fixed behind them, with Traces for the Men to hawl them by; thus a number of Cannon may be made to advance and face an Enemy to ſome Advantage, eſpecially againſt ſmall Arms.

Since theſe rolling Breaſt-Works muſt be of great Importance to that Power which is Maſter of the Seas, in the whole Progreſs of diſtreſſing an Enemy's Sea-Coaſts; I would earneſtly recommend them to my Reader's thorough Conſideration, for it would be tedious where Brevity is intended, to

expatiate further on the many Purpoſes to which they are capable of being applied.

CHAP. VI.

Of ſcaling Ladders.

PRocure the longeſt Poles that can be got, of two Inches and three Quarters in diameter; Aſh is the Wood which is moſt eligible, but as they ſhould be thirty, or five and thirty Feet in length, which *Engliſh* Aſh ſeldom runs to, clear of Knots, young Fir Trees may ſerve the Purpoſe, for Poles ſawed out of Timber will not be ſo proper, as not being ſo tuff and ſtrong. The middle Part of theſe Poles ought, as I obſerved, to be two and three Quarters of an Inch in diameter, but they ſhould be ſomewhat tapering towards each End; when theſe Poles are to be converted into Ladders for ſervice, two of them muſt be ſet parallel at a proper Diſtance aſunder, and kept ſo by proper Iron Work that will not damage them; round Loops or Sockets at each End of the Bars, to put on upon the Poles, ſeem likely to anſwer this Purpoſe beſt, and they may be faſtened at the Ends by Skrews. The Steps of theſe Ladders ſhould be ſmall Ropes, ſtretched tranſverſly between the Poles, their Height one above another ſhould not exceed one Foot; they might indeed be eighteen Inches Diſtance, but then a Man muſt be obliged to give a Spring every Step that he aſcends, and this would require a ſtronger, and conſequently a heavier Ladder.

Such a ſcaling Ladder, wide enough to hold two Men a-breaſt, and thirty or thirty-five Feet long, will admit of ſix Men upon it at a Time, and the Ladder not weigh much above one Hundred

dred and twenty Pounds: It might perhaps be expedient to have a ſmall Pole fixed with its End about ten Feet from the Top of the Ladder, to be in readineſs to raiſe the Top when neceſſary.

When the Ladders are out of uſe, the Poles will lie almoſt as cloſe together in a Ship as ſo many other Poles, for the ſmall rope Steps will be a very inconſiderable Hindrance to their Stowage.

Another ſort of Ladder may upon trial prove more uſeful in the open Attack of a Place by Eſcalade, in a new Manner hereafter deſcribed.

This Ladder ought to be about forty Feet long, and made of good Rope, with a proper Chain about twenty or thirty Feet long, properly faſtened to the End of the Ladder that is to be uppermoſt; and to the other End of the Chain let a Ball of nine or twelve Pounds be well ſecured, ſo that the Ball may be fired out of a Gun and draw the Ladder after it acroſs the Ditch, and fix it to its Place by the Ball plunging a good Way into the Defences of the Place, drawing the Chain in after it.

Conſidering the great Advantages that might accrue, eſpecially to *Britain*, from a right and ready Manner of attacking Places by Eſcalade, it may be worth while to exerciſe the Soldiers at home in time of Peace, in this important Part of Military Operation. It will require Experiments to diſcover rightly how to make and uſe this Ladder.

CHAP. VII.

Of a Bridge to croſs a Ditch, whether dry or full of Water.

GREAT Ditches are uſually made from ninety to a hundred and twenty Feet wide, more or leſs; thoſe of Out-Works from about fifty to ſeven-

ty Feet, but as the preciſe Breadth cannot always be obtained, it will in this Caſe be neceſſary to be provided with two Bridges, one longer than the other; the longeſt with folding Parts, to croſs from fifty to eighty-four Feet wide, and both Bridges together to ſecure the Croſſing from the Breadth of ninety to an hundred and thirty Feet; the Bodies of theſe Bridges are to go on a pair of Wheels, fixed at either End, each Wheel being about twenty Feet diameter, and to tread eighteen or twenty Feet aſunder.

Suppoſe the Body of the Bridge which is to be puſhed into the Ditch, to be thirty Feet long, from the fore Part of one Axle-Tree to the hinder Part of the other, which leaves the Semi-Diameter of each Wheel without any Bridge; and as it may be impoſible to know the Breadth of the Ditch to a certainty, it will be adviſeable to have in readineſs thirty-eight or forty Feet of ſpare length of Bridge, to be uſed if neceſſary, which may be eaſily provided, by having a folding Part of thirty or thirty-five Feet long, faſtened to the after Axle-Tree with ſtrong Hinges, and its after End, (for the better Convenience of travelling) ſupported by Wheels ten Feet high, ſo that the Men appointed to convey it will have ſufficient Room to hawl under the Bridge, and the Wheels may be taken away at pleaſure, as ſoon as the main Body of the Bridge is puſhed into the Ditch; and inſtead of the Wheels, the outer End of the folding Part may reſt upon the covert Way, and by puſhing forward or hawling backward the ſaid main Body, the Bridge may be made ſuitable in length to the Breadth of the Ditch; and for the more convenient moving the ſecond Bridge over it, (which ſhould be narrower than the firſt) it would be proper to fix firſt a folding

Fig. 1.

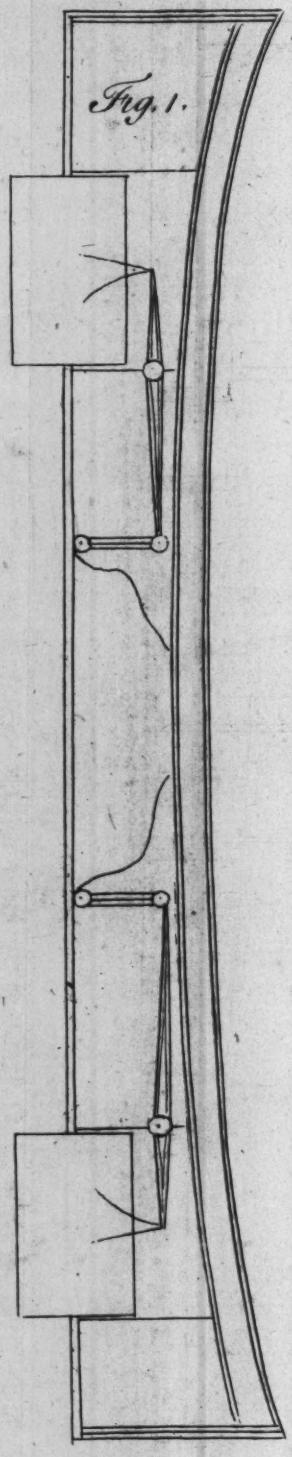


Fig. 2.

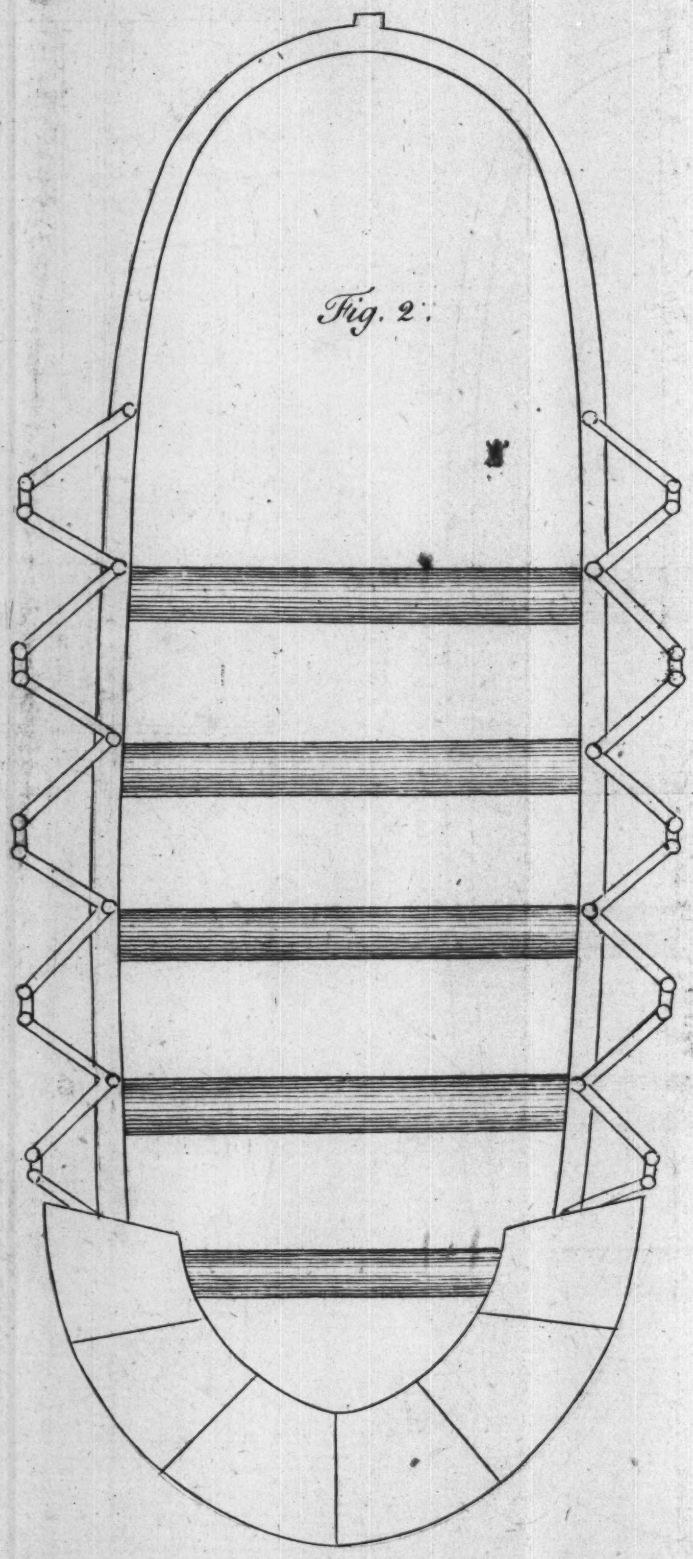


Plate I

Fig. 3

Fig. 5.

A Ladder made of Cordage to be fixed by Cannon.

Fig. 4.

A Pole sided Ladder with Cordage Steps.

ing Part at the fore End of this ſecond Bridge, of about twenty Feet long, to face the Ditch.

Suppoſe the Ditch to be one hundred and thirty Feet wide, or a little more, though few exceed ſuch a Breadth, and not many are ſo wide, firſt puſh the Bridge as above deſcribed into the Ditch, till only two or three Feet of the after End remain upon the covert Way, which muſt be fixed down with three or four Iron Stakes, or well faſtned with Ropes to the remaining Parts of the Palliſades of the covert Way*: This Bridge will advance ſixty or ſixty-two Feet into the Ditch, and leave ſixty-eight or ſeventy Feet of the Breadth of it, for the ſecond Bridge to be puſhed along the firſt already in the Ditch.

The main Body of the ſecond Bridge, like that of the firſt, is underſtood to be thirty Feet long, with folding Parts at the Ends, each twenty or thirty Feet long, that at the after End to be ſupported by two Wheels, and the fore Part to be elevated to an Angle of about forty five Degrees, and kept ſo ſuſpended with Chains till the Body be ſo far advanced into the Ditch, as that the after folding Part may reach about two Feet, more or leſs, on the Body of the firſt Bridge, which being already forwarded to the length of about ſixty or ſixty-two Feet into the Ditch, the after folding Part of the ſecond Bridge will make twenty Feet more, and with its Body, one hundred and twelve Feet in the whole, whereby the foremoſt folding Part having no more than eighteen Feet of Ditch to cover, will reach a conſiderable way up the Parapet, and ſo be a Means of affording the Men aneaſy Entrance into the Place

* Theſe Wheels being twenty Feet high, will go over any Obſtruction ſeven Feet high.

As Men are to be employed in drawing and puſhing forwards theſe Bridges, Traces muſt be fixed under them (ſo that the Men will in ſome Degree be ſecured againſt ſmall Shot) ſufficient to contain as many, or near as many as may be ſufficiently able to hawl the Bridge to the Edge of the Ditch; but as the Men cannot enter a deep Ditch full of Water, it will be neceſſary to have a Trail behind the Bridges, where a requiſite Number may hawl and aſſiſt thoſe under the Bridge, by which Trail alone the Bridge may be forced or puſhed acroſs the Bottom of the wet Ditch; for as the Bridge when emerged in the Water will be buoyed up almoſt to float, a ſmall Degree of Strength, compared with what is neceſſery to puſh it on the Ground, will ſuffice to force it on when in a wet Ditch; and if the Ditch be dry the Men may do their Buſineſs in it.

In the Caſe of a dry Ditch, a Trail will not be abſolutely neceſſary, unleſs the Diſtance the Bridge is to be advanced to, be very conſiderable.

It may happen that the Place may be alarmed, therefore Quilts, Muſket proof, ought to be provided, to hang on each Side the Bridge, to ſecure the Men hawling under it from ſmall Shot*. It is ſuppoſed the Barb Batteries are ſilenced before this Bridge advances near, if the Place is alarmed.

Although (as I have obſerved) Ditches are of various Breadths, two ſuch Bridges as I have been deſcribing will ſerve for croſſing any Ditch from eighty-four to one hundred and thirty Feet wide, for if it be no more than eighty Feet, it will admit of the Bodies of both Bridges between the Scarp and Counter-Scarp, and the folding Part forward will lie againſt the Parapet of the Place, and that behind

* Such Engines are ſuppoſed practicable to be brought againſt Sea-Ports, but too cumberſome for in-land Service.

behind will reſt on the Covert-Way; The long Bridge alone with its folding Parts will command the Croſſing of any Ditch from fifty to eighty-four Feet over, and how theſe two Bridges are to be uſed together in croſſing one of one hundred and thirty Feet over, has been already explained.

CHAP. VIII.

Of the Advantage of Feints in Landing Troops, &c.

ALthough it be unqueſtionable that it is in the Power of *Britain* to attack any Place upon an Enem'ys Coaſt with the greateſt Probability of Succeſs, when common Prudence and Reaſon encourage an Attempt; yet as the executing ſuch Services with the leaſt Loſs will be the moſt commendable, the proper Uſe of Feints ſhould be ſome Time had recourſe to, for attaining this deſirable End.

For Inſtance; ſuppoſe that it be determined to land in the Night Time, it will (I think in the firſt Place) be of Service to keep the Enemy ignorant of the Intention as long as poſſible, by lying at a good Diſtance from the Shore, if the Wind is favourable, or by any other Means, till the Afternoon, and then diſpatch reconoitring Boats to diſcover the beſt Landing Places, *&c.* (but it would be better if they were known before the Expedition ſail from *Britain*) near the Place propoſed to be attacked, attended by Frigates and Cutters, built on the beſt Plan to ſail and row, and followed by the whole Fleet *.

Thus

* It has the Appearance of Negligence in the Britiſh Government not to be acquainted with the Landing Places upon the

Thus the Landing Places will be diſcovered for the Forces to make the earlieſt Uſe of them; and as the Succeſs of a Surprize or ſudden Attack is much facilitated by aſſaulting the Enemy unexpectedly, the Landing ſhould be conducted with the greater Care and Expedition.

Having conſidered the Landing Places with regard to the principal Object, it is natural to imagine the moſt advantageous Landing Places are moſt guarded, in order to prevent or obſtruct a Landing there; agreeable to theſe Conceptions I think it would be right to chuſe a Landing Place a good Way from the Object, there to make a Feint to Land*.

If it ſhould be thought proper to land in a very dark Night, Veſſels muſt be laid in order to hang Lights out to direct Boats in their Courſe to the real Landing Place deſigned, but

If two Lights, as is common, are placed to be kept in one, in order to be a Direction to the Landing Place, the Enemy on the Shore will too eaſily underſtand it; therefore I would recommend to have three

the Coaſt of *France*, eſpecially the moſt particular Places. Though I am not well acquainted with the Behaviour of the *French* to Travellers along the Coaſt, I am well aſſured the *French* may very eaſily get good Information in regard to the Places of Advantage on the *Britiſh* Coaſt, where Troops may Land.

As reconnoitring Boats will be built ſo as to go faſter than any Boat known in common Uſe, and having the Frigates to fly to in caſe of Purſuit, they may make bold with the Shore without Apprehenſion of Danger from any Purſuit the Enemy may make.

* Such Schemes are beſt contrived on the Spot, when Winds and Weather, *&c.* can be conſidered, yet written Schemes may introduce ſome uſeful Hints, and a General ſhould know how to uſe Cunning as well as Courage. The Place pitched upon for the Feint ſhould not be quite unconnected with a reaſonable Scheme, if it is, the Enemy will diſcover it to be a Feint, and too eaſily gueſs the Truth.

three Lights, two of which hung at the Main Top gallant Maſt Head, to be on in the Line directing to the Place where the Feint is propoſed; the third Light to be hung low, advanced toward the real Landing Place, in a diſtinguiſhing Manner, ſo that the three Lights to a Perſon ſtanding in a Line to, or at the real Landing Place, will appear in an equilateral Triangle; the Light advanced in its proper Place and hung low, will be a ſufficient Direction to the Landing Place, and the Enemy on Shore will not readily underſtand it.

Every thing being ready for landing, the Boats deſigned for the Feint ought to put off from the Ships in Day Light, that the Enemy may perceive what Place they are deſigned for; and there ought to be no more Men in the Boats than what are ſufficient to row them a head, and

More effectually to deceivethe Enemy, I would have placed in the Boats a Number of Blocks with Hats on, that may appear like Men at a Diſtance; I do not mean that every Boat is to carry a Number of theſe Blocks, but only as many as may be ſufficient to deceive the Enemy at a Diſtance, ſuch as all the Boats in Front and Flank, with a few others diſtributed amongſt the main Body, in the beſt Manner to cover the empty Boats.

When the Boats has continued their Courſe a proper Time, ſo that the Enemy may eaſily underſtand what Place they are intended for, a Signal may be made, as before muſt be concerted, to make the Men lie upon their Oars, as if waiting for Orders, *&c.* ſo ſpend Time that it may be ſomething dark before the Boats approach near the Shore, to prevent the Enemy diſcovering the Deception.

If the Shallowneſs of the Water, near the Shore, will not admit of Frigates to lie near, to cover the Landing, or rather to make the Feint deceive the

Enemy

Enemy more effectually, the Veſſels with the counter Bottoms (deſcribed in Chap. III.) ought to be ſent before the Boats, and to take their Stations to compleat the Feint, ſo that the Boats may lie with their Ends to the Shore, in a Line between thoſe Veſſels.

The Boats having up their Defence (deſcribed in Chap. II.) may begin firing* upon the Enemy's Troops, if any appear; and if no Troops appear, I think it would not be amiſs to expend a little Powder in firing after its quite Dark, to amuſe the Enemy; for in ſuch Caſes every Party doth not exactly know where others may be drawn to and engaged in the Night, ſuch ſham Firing may miſlead the Enemy, and perhaps draw their Forces and Attention that Way, and faciliate the real Landing†.

I hope to make it appear (in the Courſe of this Work) that it is very practicable to have ſuch a Number of Veſſels with Cannon to lie near the Shore, in any Place where Troops can land, that ten Thouſand regular Troops on Shore ſhall not be able to hinder the Landing of the leaſt Number of Troops.

Though the Landing a Number of Men in the Face of an Enemy that cannot beat them in the Field, can only anſwer the End of a Feint, or amuſe an Enemy, yet the Advantage of being able to land any Number of Men at Diſcretion, notwithſtanding a much greater Number of the Enemy

* As there is no Landing intended here, firing from the Boats can produce no bad Conſequence.

† The Advantage of having Boats appears by being enabled thereby not only to ſend Diviſions of Boats ſeveral Ways with Shams in ſuch Numbers that the Enemy will not be able to know where the Landing is intended, but alſo to Land all the Troops together, who may gain Advantages while the Enemy in Parties are obſerving the ſeveral Diviſions of Boats with Shams.

my is looking on, may, in many Caſes, be of great Utility, for Inſtance,

Suppoſe it is determined to attack a very ſtrong Sea-Port, whoſe Strength renders an Attack unſuſpected, and Succeſs depends wholly upon a Surprize, or ſudden Aſſault, to ſurprize ſuch a Place, let another Sea-Port be fix'd on to make a Feint upon, about twenty-five Miles Diſtance,* more or leſs, from the Place to be attacked.

Having both fix'd upon a Landing Place for the Feint, and the Plan of Execution, the Veſſels with counter Bottoms and Cannon (deſcribed in Chap. III.) are to take their Stations near the Shore, that the Troops may land under their Cannon, and intrench before Night if neceſſary; this may be done with little, perhaps no Loſs, as the Veſſels with one hundred Cannon, if neceſſary, may lie ſo very near as to fight their Guns in five or ſix Feet Water.

Intrenchments being thrown up (See Plate II) before Night, and every thing done in order to ſecure the Troops, it is natural to believe that Expreſſes will be diſpatch'd, and Forces put in motion, to ſuccour the threatened Town: If the Wind is favovrable, proceed as ſoon as dark to ſurprize the Place intended; if the Wind is not favourable, let the Troops remain, and next Day ſend more Troops aſhore and proceed, that the Enemy may have no Suſpicion it is a Feint (Care muſt be taken that none of the common Men, and very few Officers know what is intended

* Twenty or thirty Miles, or as far as Boats can row in a Night to ſurprize a Place before Morning, appears a proper Diſtance, as there is an Advantage in the greatneſs of the Diſtance, ſo that a Fleet of Boats can but run it to ſurprize the Place before Morning, having no Time to ſpare, for the greater the Diſtance, the leſs will the Place be alarmed, and a Surprize will the more eaſily ſucceed, and the greater the Diſtance, the longer will Troops be in marching from one Place to reinforce the other.

tended) thus a Day or two may be ſpent, in order to gain a fair Wind; but upon a powerful Enemy's Coaſt, too much Time muſt not be ſpent, leſt they have Time to collect their Forces from far.

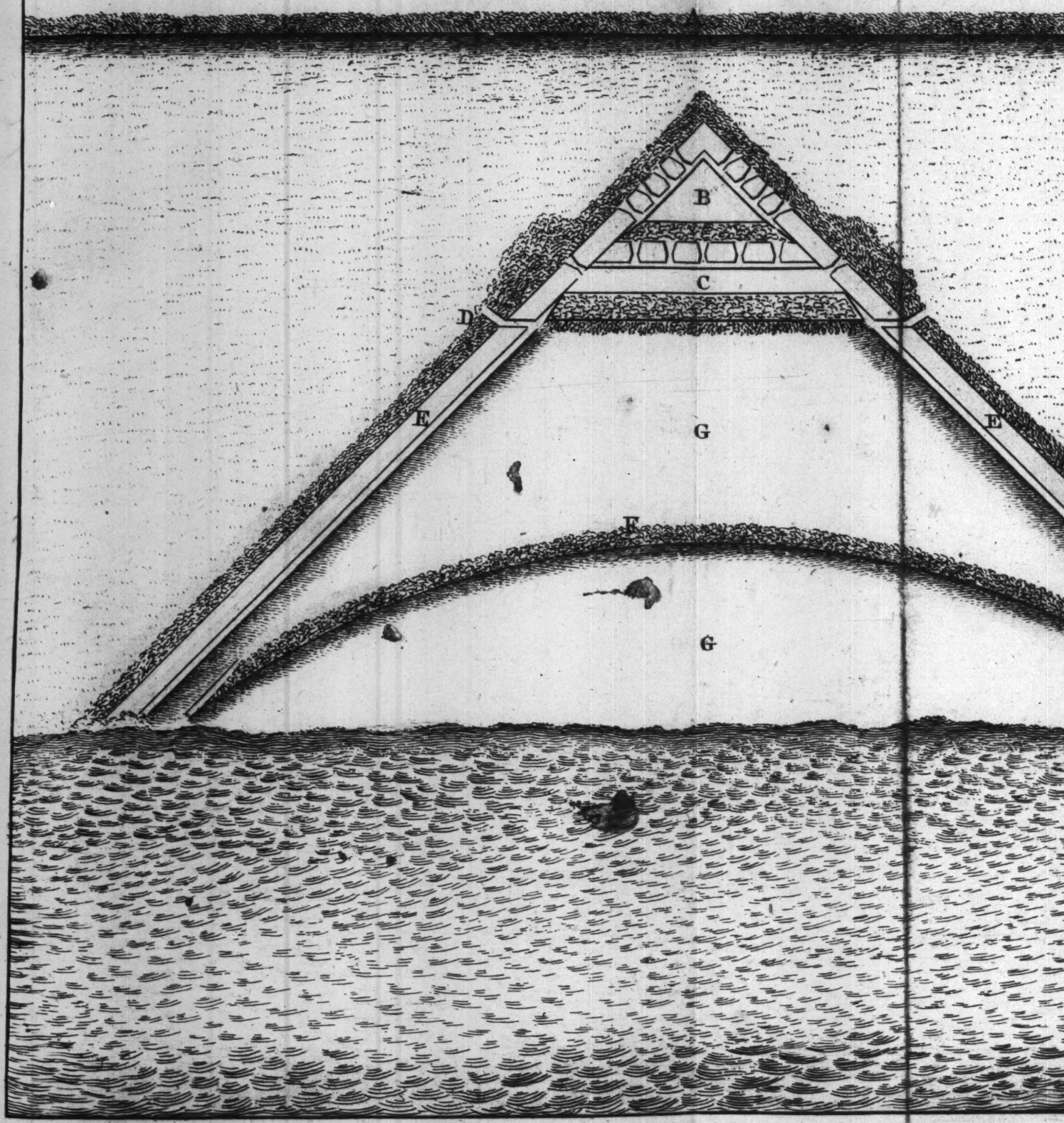
The ſecond Night, as ſoon as it is dark, the Boats are to take off all the Men, and proceed to ſurprize the Place, if contrary Winds do not render it impracticable; for by this Time all their Troops deſigned will be ſent from that Place to where the Feint is made, and will not only be without fear of an immediate Attack, but will have fewer Troops to defend it; and the Surprize is more likely to ſucceed, than if it had been attempted without making the Feint abovementioned, conſequenty affords a better Proſpect of Succeſs. * The Enemy ſeeing ſo many Veſſels with Cannon lying ſo near to defend the Troops, will ſcarce venture to attack them, though greatly ſuperior in Number, eſpecially if thoſe juſt landed are drawn up according to Plate II.

It is eaſy to conceive that a Nation which undertakes to diſtreſs an Enemy's Sea Coaſt ought to be Maſters at Sea to do it ſecurely and effectually.

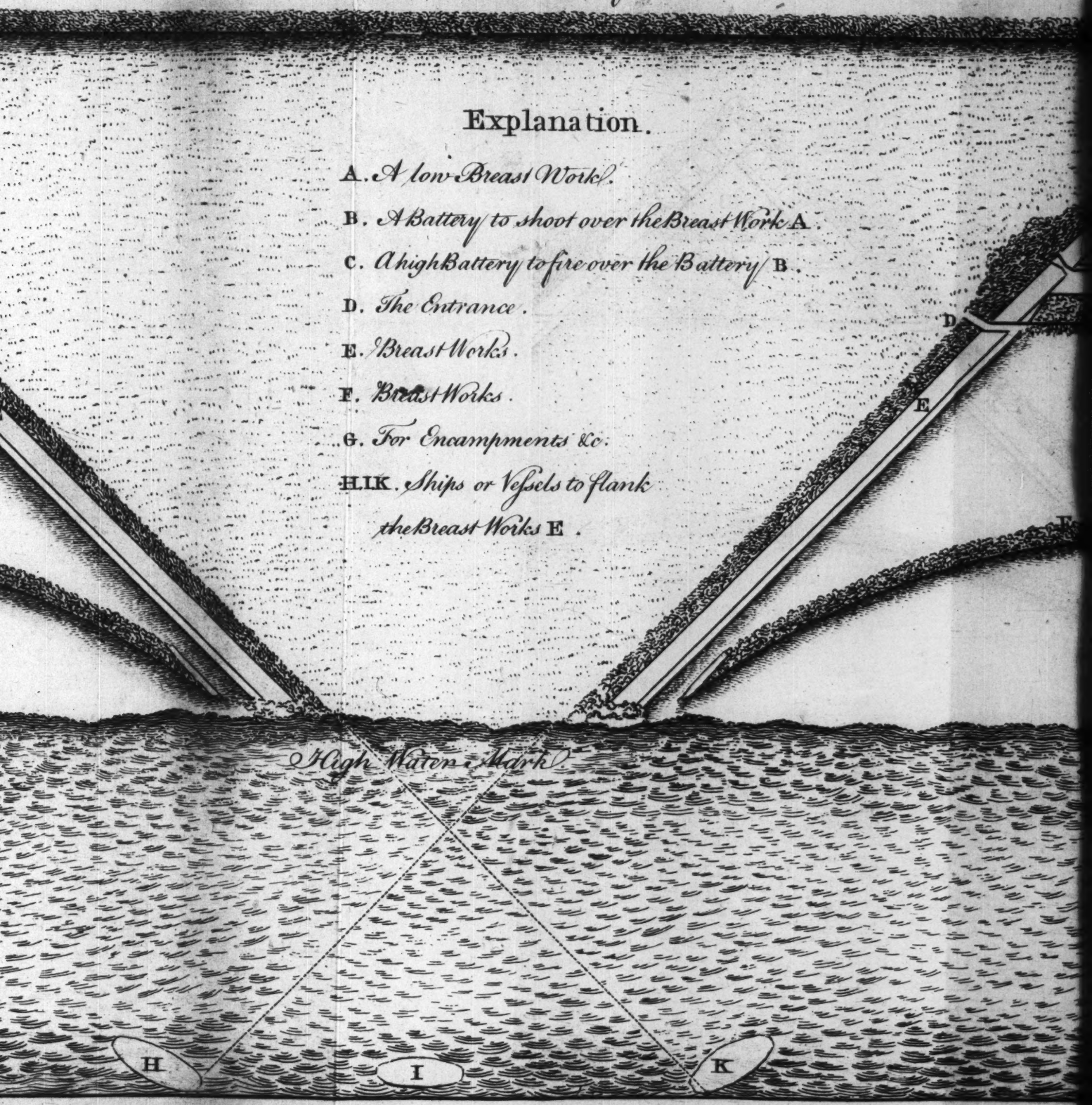
CHAP.

* A Fleet having as many Boats as will either land or imbark all their Troops at once, need not be much afraid of the ſudden change of Wind, to raiſe the Sea, that they cannot re-imbark their Men, eſpecially in Summer; for in fine Weather it ſeldom happens that the Wind upon changing, from off Shore to blow out of the Sea upon the Shore, raiſes a conſiderable Sea in ſo ſmall a Time, as Boats will require to row a Mile or two, to fetch Troops off the Shore.

Temporary works to secur



ecure a Retreat, and where Troops may defend themselves till they can be



ary works to secure a Retreat, and where Troops may defend themselves

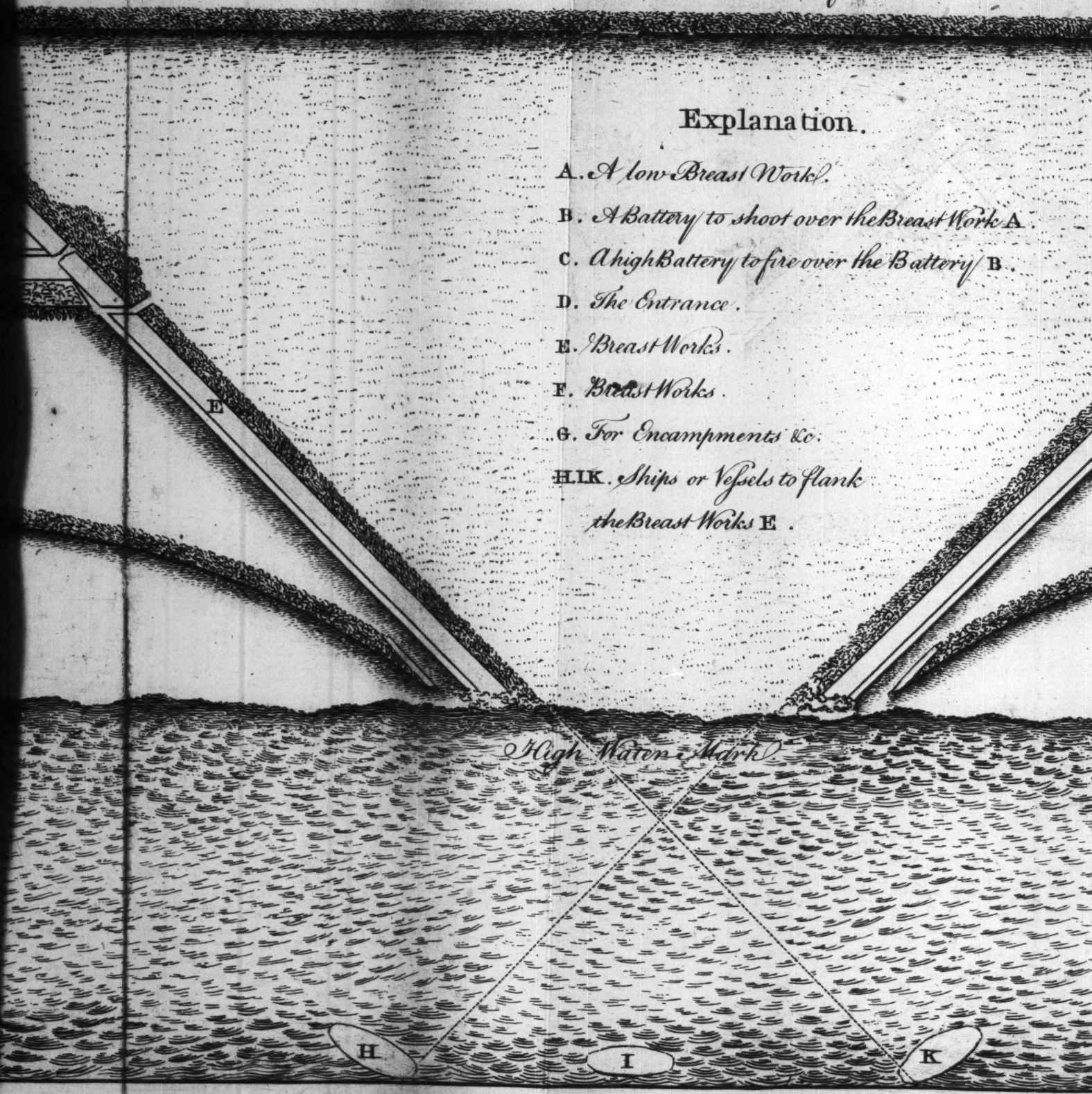
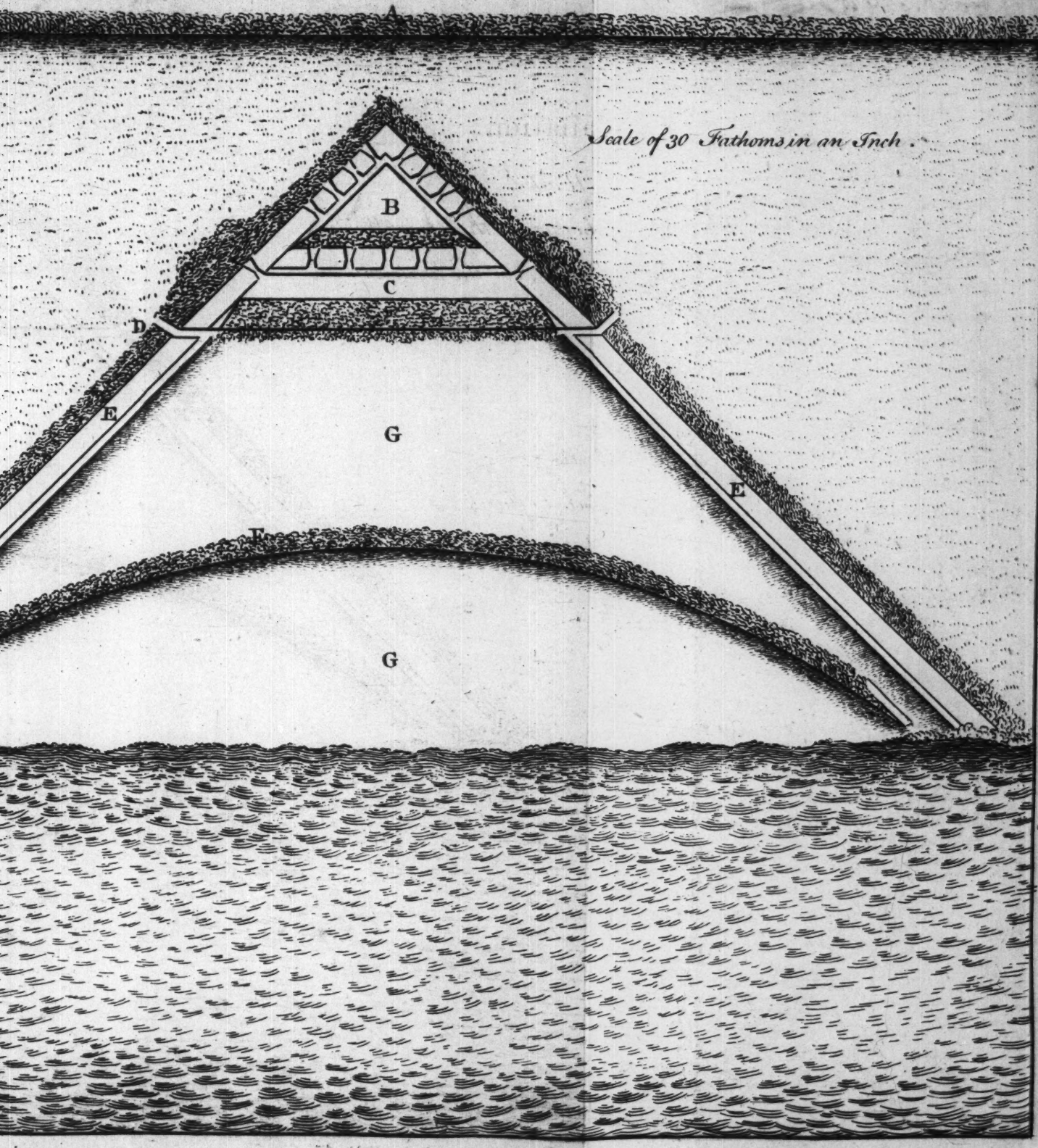


Plate II

lves till they can be Imbark'd.



CHAP. IX.

Of Real Attacks.

BEING arrived in ſome convenient Road, or Bay, *&c.* as near as poſſible to the Place to be attack'd, if it is thought practicable to take it by a ſimple Eſcalade, no Time muſt be loſt in landing the Troops, and every neceſſary for that Purpoſe; but if that appear deſperate and hopeleſs, the Place having taken the Alarm, then—

The utmoſt Endeavours muſt be uſed to land, as ſoon as poſſible, a great Number of light Cannon, and Mortars, with every Neceſſary, which may ſoon be done by the Help of rolling Breaſt-Works, † aſſiſted with Boats, provided the Sea is tolerably ſmooth; the Troops may ſoon be landed, if Care is taken to have a ſufficient Number of Boats to land them all at one Time; the Cannon, Mortars, and rolling Breaſt-Works § being landed, they may, without loſs of Time (having a ſufficien Number of Troops on Shore) be moved forward, and placed upon

† If the Shipping can deliver the rolling Breaſt-Works, Cannon, Mortars, *&c.* within a Mile and half of the Shore, one Hundred Cannon, mounted ready for Action, may be landed in about three Hours Time, after the Ships are brought up. See the firſt Pages of Chap. V.

§ The Rolls that are deſigned to reſiſt Cannon Balls, muſt be put into Water as ſoon as may be, to imbibe ſufficient to make them heavy, and not to be burned by the Enemy: If the Rolls are work'd hard and cloſe, they will take above twelve Hours to get ſufficiently full of Water; but in a ſudden Atttack wetting the Rolls may not be practicable, for want of Time, or a convenient Spot of Water.

upon the Glacis, ‡ within twenty or thirty Yards, or Feet of the Paliſades in the Covert-Way, as will appear more evident in the two or three following Pages.

Having every Neceſſary on Shore, anſwerable to the Cannon and Mortars, with their rolling Parapets, that can be properly planted in the Diſtance between the Points of the two Ravelins on the right and left of the Front, deſign'd to be attacked.

As the Barb Batteries will do moſt Miſchief in an Attack of this kind, a ſufficient Number of proper Cannon and Muſqueteers, covered by rolling Parapets, muſt be employed to beat the Enemy from their Guns, or diſmount them; and if all the Cannon that may be brought by the *Britiſh* Navy, againſt a Place ſituated near the Sea, are well ſerved, aſſiſted by the Muſquetry, and well covered by rolling Parapets, they will be able to maintain ſuch a great and conſtant Fire, that few of the Garriſon's Troops will venture to ſhew their Heads above the Parapets to oppoſe the Eſcalade. But

If it is known that the Ditch of the Place is broad and deep, and full of Water, * and has a Revetiment, a ſtrong Garriſon well provided with large Batteries of Cannon in the Flanks, and every Thing proper

‡ When the Rolls are got to the Place aſſign'd, ſet Struts to hold them, that they may better reſiſt the Balls, till they can be ſufficiently ſtaked and earthed, by driving Stakes into the Ground prepared and ſhod with Iron for that Purpoſe, and throwing Earth over them as faſt as poſſible, to make a ſtronger Defence; but in a Surprize, or ſudden Attack, the Rolls can perhaps only be ſtaked. *N. B.* By Means of rolling Breaſt Works, the covered Way of the ſtrongeſt Place may ſoon be taken.

* In ſurpriſing Places in Summer, whoſe Ditches are full of Water, every Man that is to croſs it ſhould have a broad Belt round his Body, cloſe under his Arm-pits, with part before and part behind, (ſo large as not to hinder the Uſe of his Arms) to blow

proper for a good Defence. The Barb Batteries, and the Guns in the Flanks of one or two Fronts at leaſt muſt be ſilenced, before an Eſcalade is attempted; but, perhaps before the Guns in the Flanks can be ſilenced, the Ravelin, or other Works before the Curtain muſt be taken, which probably may ſoon be effected, by Means of the great Number of Cannon, Mortars, and rolling Breaſt-Works, in the following Manner.

Every Neceſſary being landed, and accompanied by at leaſt three Times the Number of Troops that are in the Garriſon, and as many Sailors as can be ſpared from the Fleet to aſſiſt in rolling the Breaſt-Works, &c. to the Place, advance in the Night (undiſcovered if poſſible) with ſo many light Cannon as can be planted in a proper Manner againſt the whole Length of the Fronts to be attacked, and a good Number of Mortars, with a great Number of rolling Breaſt-Works to be rolled in the Night as near the Defences of the Place as can be done ſafely, without being diſcovered; at the ſame Time a ſufficient Number of Cannon, of eighteen or twenty-four Pound Shot ought to be brought forward, covered with rolling Breaſt-Works of about ſeven Feet diameter, to ſilence the Barb Batteries.

When it is near Morning move toward the Place in the following Order;

The Cannon, that are appointed to diſmount the Cannon on the Barb Batteries, ought to move on firſt, covered by rolling Breaſt Works, in order to be

blow full of Wind upon Occaſion, to prevent his Body from ſinking too low in the Water; when the Men are landed, the Wind is ſoon let out, and the Belt but ſmall Incumbrance; ſuch Belts may be of great Service to Armies in croſſing Rivers, &c. a Place upon, or near the Sea Coaſt, without a Revetiment, may eaſily be taken by Surprize. Something like Fins may be faſtened to the ſmall Part of the Legs, by which Means Men may go faſter thro' the Water.

be ready to fire upon the Barb Batteries as ſoon as it is Light,

In the ſecond Place move forward with two Lines of Rolls, the firſt Line in cloſe Order, the ſecond Line in open Order, leaving about two Feet Opening between every Roll; theſe Lines extending the whole Length of the Fronts to be attacked, and alſo to extend to the Ravelins Points, or middle of the next Curtains; on the right and left of the Attack, to cover the Attack from the Fire of the Flanks and Ravelins on the right and left, at the Ends of the Lines of Rolls, for the Fire from the Ravelins and Flank, will in ſome Degree flank the Troops on the right and left of the Attack, behind the firſt Line of Rolls, place three Ranks of Muſqueteers, one Rank to relieve another alternately, in rolling the Rolls forward, and two Ranks to ſtand under cover of the Rolls, ready to fire upon any of the Garriſon that appears to obſtruct the Deſign; proceed with theſe Rolls within about twenty or thirty Feet of the covered Way, where ſtake and Earth them well, eſpecially where the Guns in the Flanks, *&c.* can play upon them. The Guns in the Barb Batteries perhaps are by this Time near ſilenced; the Soldiers behind theſe Rolls are to continue to throw Grenades, Stones, *&c.* into the covered Way and Places of Arms, till the Soldiers there are driven out.

The light Guns, appointed to plow the Tops of the Parapets, *&c.* to prevent the Muſquetry in the Place from firing briſkly upon the Troops, are to move forward under the Cover of the ſecond Line of Rolls, (keeping a convenient Diſtance behind the firſt Line of Rolls) when both the Lines of Rolls are advanced to their proper Stations, and the front Line well ſtaked and earthed, alter the Poſition of every Roll in the ſecond Line, by hawl-

ing

ing about their Ends to an oblique Direction, ſo that the Guns may have Room to be drawn through between them, to be placed under the firſt Line of Rolls, where they are to perform their Service upon high and broad Wheel Carriages, that require no other Platform but the Ground; previous to this, every Roll in the Front ought to be fitted with a Piece to take off from each End, in order to make Embraſures, and thoſe Pieces are to fill up the Openings between the Rolls in the ſecond Line, behind which the Muſqueteers* are to be placed after the Cannon is moved to the front Line†. Theſe two Lines being compleated, and the Guns and Mortars ready to fire upon the Place, proceed to roll Rolls over the front Line, into the Covert Way, over againſt the ſaliant Angles of the Tenaillons, Ravelins, *&c.* and when there is a ſufficient Number of Rolls rolled over into the Covert Way, Men may go amongſt them and put them in Order; for in the mean Time, the Guns, Mortars, and Muſqueteers, behind the Lines of Rolls, will be able to maintain ſo conſtant and ſo great a Fire, and the Troops throw ſo many diſtructive Things into the covert Way, that very few will venture to ſhow themſelves to fire from the Place, or approach along the covert Way, in order to obſtruct the Proceedings.

When there are a great Number of Rolls rolled over, and a Paſſage made over the Ditch to the Ravelins, Tenaillons, *&c.* a great Number of

* The Muſqueteers to be tall Men, and Cannoneers ſhort Men.

† If a Number of Cannon were mounted upon Carriages with Wheels ſeven or eight Feet high, to form a rear Line of heavy Cannon and Mortars to fire over the light Cannon, Mortars, and Muſqueteers in the front Lines, it would greatly awe the Town, and contribute much toward a ſpeedy Surrender.

If Cannon were mounted eight Feet high, the Carriage may be ſo conſtructed that the Gun could be loaded and fired to good Purpoſe.

Mortars muſt continue to throw Stones, Shells, *&c.* into the Tenaillons, Ravelins, *&c.* while Miners are ſent to make a Mine or Mines, to blow up the Ramparts, or Pioneers to dig a Paſſage, throwing the Rubbiſh into the Ditch; perhaps both Miners and Diggers may be employed at the ſame Time to good Purpoſe, in order to make a Paſſage to roll Rolls into the Ravelin, both to cover the Men and to make Batteries expeditiouſly, to ſilence the Guns in the Flanks, *&c.* being aſſiſted by a great Number of Mortars placed oppoſite every Flank, in order to throw Shells, Stones, *&c.* into the Flanks and other Places. See Plate III.

While the Works before the Curtains are carrying on, and the Flanks ſilencing, collect great Numbers of Rolls before the Curtains, and alſo oppoſite to the Faces of every Baſtion, in order to croſs the Ditch in three Places, on every Front attacked, *(i. e.)* a Paſſage is to be made before every Curtain and Baſtion Face that is deſigned to be aſſaulted; when the Rolls that are to be rolled into the Water in the Ditch are at the Edge of the Water, faſten a Bag of Earth to each End before you roll them in, otherwiſe they will ſwim very buoyant at firſt, if they have not before been laid in Water twelve or fourteen Hours to ſoak; when the Rolls appears above Water, and every Paſſage compleated, ſend over each Paſſage a Number of Men, with Iron Claws fixed to their Feet and Arms, to enable them to climb better in order to receive the Ends of Ropes or other Ladders, (from other Men ſent over with them) and faſten them, that Men in Arms may mount the Rampier, or Pioneers may be ſent over the Ditch, to make three or four Places like Steps, horizontaly along the ſlope of the Rampire, that two, three, or four Ranks of Grenadiers may ſtand eaſily, and prepare to mount the Rampire while Troops are croſſing

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the Ditch, and ranging themſelves along the Berm or Fauſs Bray, if any be, in order to ſuſtain them.

When the Troops are croſſing the Ditch, and placing themſelves behind the Rampire, *&c.* the Cannon muſt be made to graze on the Top of the Parapets, and the Mortars on the right and left keep a briſk Ricochet Firing into the oppoſite Baſtions; the Cannon and Mortars being properly placed to fire a Ricochet along the Inſide of the Parapets of the Curtains and Baſtions Faces that fronts the Attack, ſo that few Troops of the Garriſon will be able to ſtand upon the Rampire to oppoſe the Aſſault.

If the Situation of the Town is ſuch that it can be attacked by Sea and Land at the ſame Time, and that one of the Attacks by Land can be made near the Sea, where Veſſels can come to aſſiſt, ſuch an Attack will in all Probability ſucceed ſooner and better. Or

If the Situation is ſuch that three or four Sides can be attacked at once, with a Force againſt every Side equal to that before mentioned, the Place will be more eaſily maſtered. I imagine it cannot be denied but a maratime Power, which is Maſter at Sea, and can ſend a ſufficient Number of Troops to maſter for ten or twelve Days, ſix or eight Days may perhaps anſwer the End, (as every thing may be landed at the moſt convenient Landing by means of the floating Batteries deſcribed in Chap. V.) a Part of the Enemy's Country near the Sea, may come ſo very unexpectedly againſt a Place in the prime of Summer, and land ſo great a Force of Cannon and Mortars, and every Neceſſary before mentioned, for taking a ſtrong Sea-Port, that Succeſs in deſtroying the Town, Harbour, and Shipping, may with Reaſon be depended on.

If there are Counter Guards before the Baſtions, the Place muſt be taken at the Curtains, while a great Number of Mortars are employed in throw-

ing into the Baſtions, eſpecially into the Flanks, Shells, Stones, Grenadoes, and every other deſtroying Engine that can be invented, to hinder the Garriſon from making their Defence; the Front attacked* muſt at the ſame Time be furiouſly enſaladed.

In the next Place let it be conſidered what a well provided Town can do againſt the Attack beforementioned: They will have little Time to raiſe Palliſadoes, or make Retrenchments, and their Cannon and Mortars will do them but little Service againſt ſo great a Number without, and the Attack will be ſudden, by Reaſon of the ſudden Approach of a Fleet, and the rolling Breaſt-Works not only rendring the Covert-Way almoſt uſeleſs to the Place, in ſo very little Time; but alſo in a great Meaſure prevent the Sallies; and the Mines, the only Danger to be feared, will hardly be got loaded and fitted ready to ſpring in the Surprize and little Time the Place will have to make its Defence; Suppoſing

* As the Ricochet Batteries muſt be nearly perpendicular to a Line, to enfilade it properly, it may, therefore, be proper to ſhew how the Line of a Curtain may be found without the Place.

The Curtain may always be ſuppoſed paralel to the exterior Side of the Polygon, therefore find the Line of the Baſtions Points, which is very eaſily done by bringing the Baſtions Points in a Line, if the Works before the Curtain do not hinder the Sight, and then conſult how many Feet or Yards the Receſs of the Curtain is, and erect a Pole, at leaſt Muſket Shot from the Place, of a ſufficient Length as near the Line of the Curtain as you can gueſs, and hoiſt a proper Man up to its Top, with a Glaſs if its a good Diſtance; the Man at the Top of the Pole will diſcover ſomething nearer where the Curtain Line falls. Erect another Pole and hoiſt an Engineer up to its Top; by this Manner of proceeding to place three or four Poles, the Line of the Curtain will be found exactly. There are other Methods to find the Line of a Curtain without the Place, but that above being as eaſy and certain as any, I omit the others.

Suppoſing it as well prepared as Towns generally are that apprehend no ſudden Attack. If the Towns attacked in the Manner here deſcribed do not hold out after the Danger is become greater than the Danger Places were generally in that have lately ſurrendred, there will be no Occaſion of lodging Troops on the Slope of the Rampire, *&c.* to ſtorm the Town: For

It is not improbable but the Place will ſurrender ſoon after the Cannon and Mortars begin to fire from behind the Lines of Rolls, as the Troops of the beſieged will be at firſt driven out of the Covert-Way, and Places of Arms, by the Troops behind the Lines of Rolls, they having ſo much the Advantage of the beſieged, by being ſecured upon the Ridge of the Glacis, and can throw Shells, Stones, and every other deſtroying Engine, under ten or twelve Pound weight, into the Covert-Way and Places of Arms, the Beſieged cannot reach the Beſiegers in the ſame Manner, they having to throw upward, by which Advantages the Covert-Way, in all probaility, will be taken in the firſt twenty-four Hours, and the Surrender of the Town will ſoon follow.

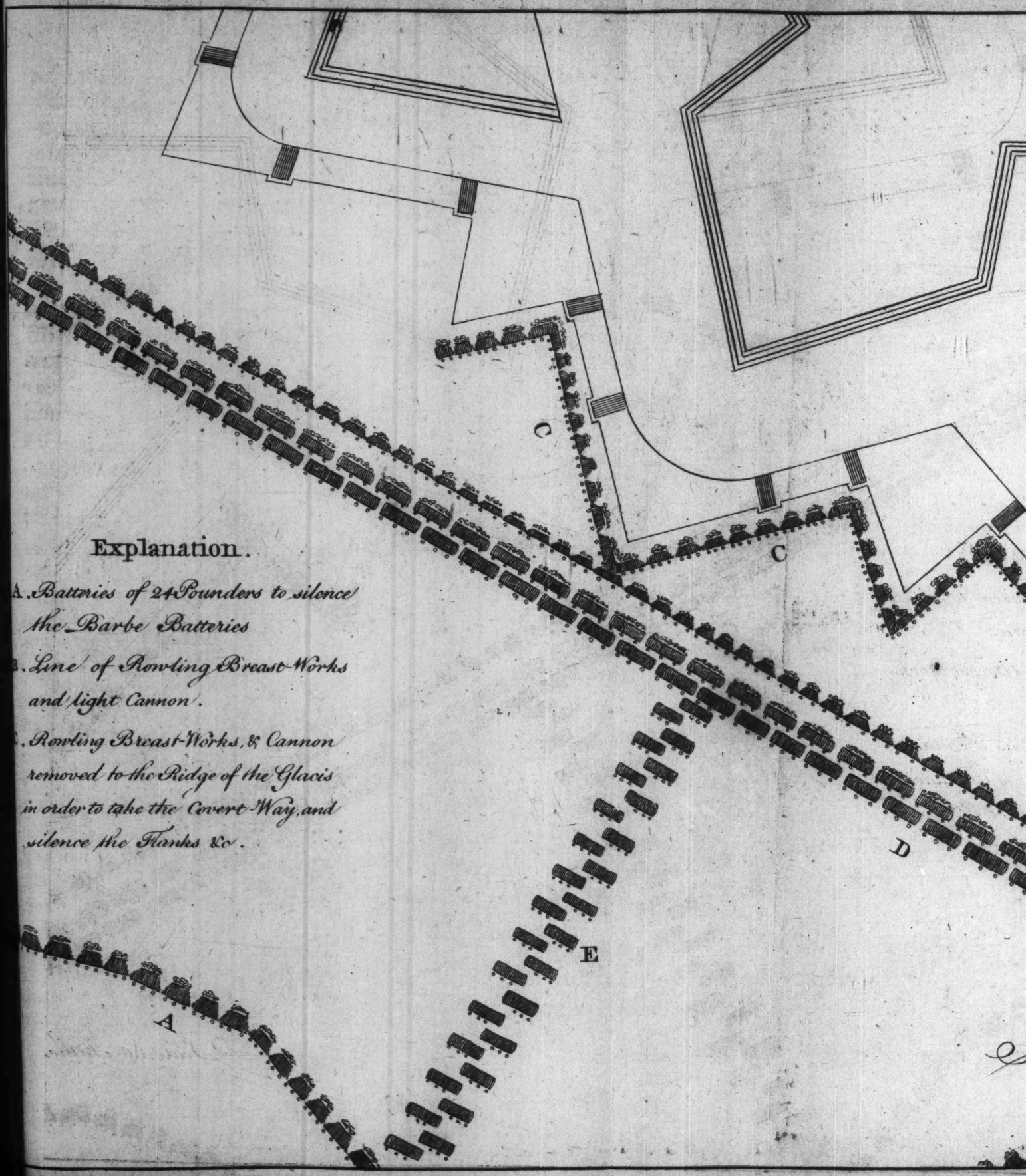
If the Place have a dry Ditch that cannot be filled with Water, proceed in the Manner already deſcribed, and take the Covered-Way, and throw Shells, Grenades, Stones, and every Thing that will beſt drive the Garriſon out of the Flanks and Works before the Curtains, and being prepared with light Rope Ladders, that have Chains of a proper Length fix'd to them, with Balls at the other Ends to be put into Cannon, in order to be ſhot acroſs the Ditch into the Rampier, to hold the upper Ends of the Ladders faſt, leaving the after End hanging down the Revetiment, ſo that the Troops may go haſtily acroſs the Ditch and mount

the Ladders * without being obliged to ſtop to fix them, by which Delay many are generally killed.

If the Place has a ſecond Covert-Way, this Covert-Way muſt be taken in the Manner already deſcribed, and the Ditch may ſoon be made paſſable with little Loſs, by Means of the rolling Parapets; but if a Ditch is to be croſſed before the Fire of the Place is ſilenced, advance to the Ditch with a ſufficient Number of rolling Parapets in front, ſtake and earth them, cloſe at the Edge of the Ditch, in order to keep off the Enemy's Shot, and lay ſtiff Planks, with one End upon the Rolls that is ſtaked and earthed, to roll other Rolls up upon, in order to roll them over the front Rolls that are ſtaked and earthed, ſo that they may roll into the Ditch to fill it up: If it is not thought proper to take Time to make a Paſſage over it with Earth, the Side next you will be firſt full of Rolls, upon which begin to throw Earth over the rolling Parapets, that lie for a Defence, till you have thrown over a Quantity ſufficient to make a Plain, to advance your rolling Parapets upon, in order to roll over more Rolls, to fill more of the Ditch; keep the firſt Rolls where they were fixed at firſt, and roll other Rolls over them to an advanced Defence, over which roll more Rolls to fill up the other Part of the Foſs, which being ſufficiently full of Rolls, if a great Fire is made from the Town, throw Earth over the firſt fixed Rolls, then over the advanced Rolls, from Hand to Hand, and ſo continue five or ſix Caſts, or more, if Need be, from Hand to Hand, over the advanced Rolls, till the Ditch is ſufficiently filled up for a Paſſage over.

Thus

* This Manner of fixing Ladders has not been tryed that I know of, but if it carry the ſame Face to Engineers, who are practiced in thoſe Arts, as it doth to me, it is worth beſtowing an Experiment upon.

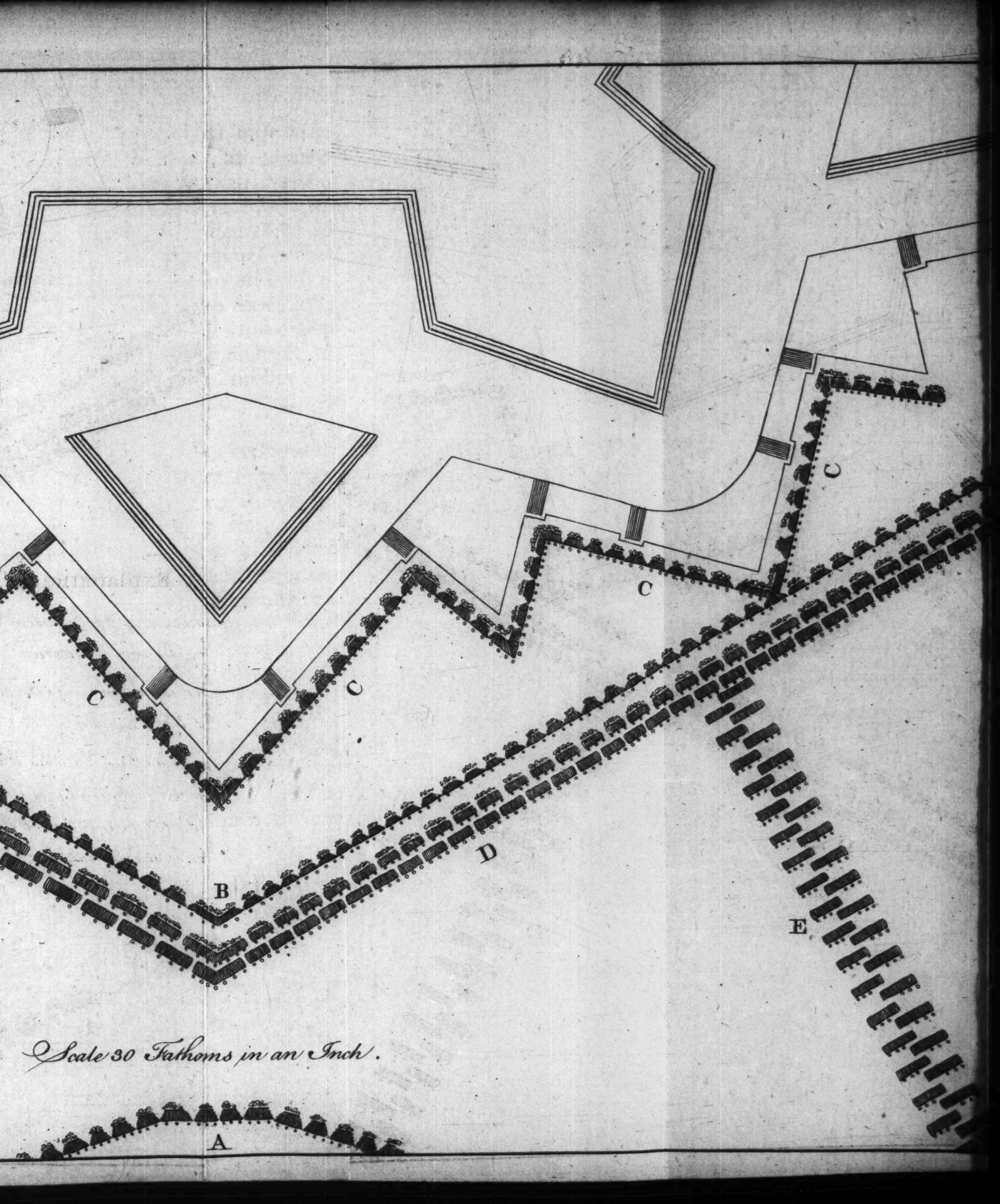


Explanation.

A. Batteries of 24 Pounders to silence the Barbe Batteries

B. Line of Rowling Breast-Works and light Cannon.

C. Rowling Breast-Works, & Cannon removed to the Ridge of the Glacis in order to take the Covert-Way, and silence the Flanks &c.



Scale 30 Fathoms in an Inch.

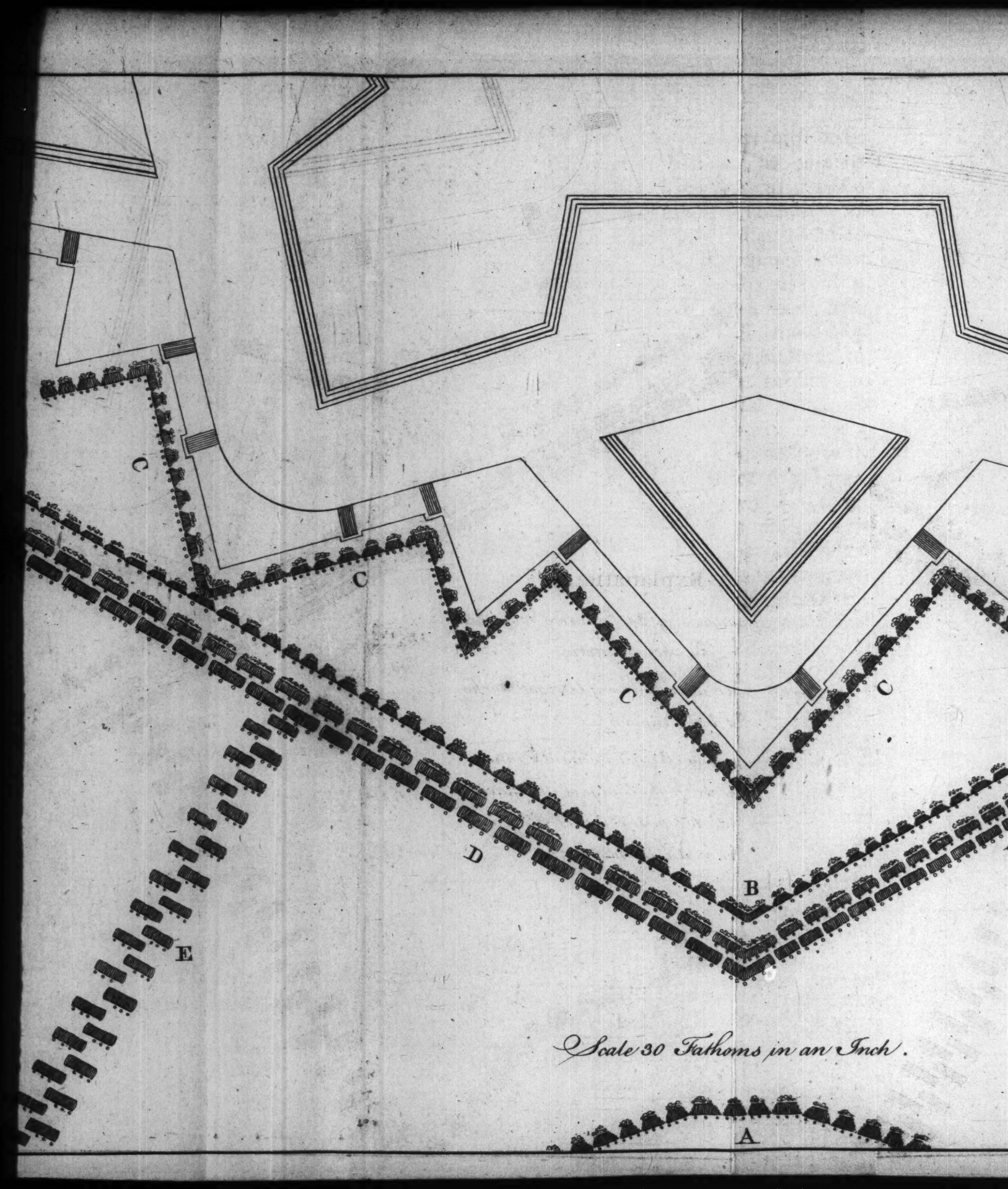
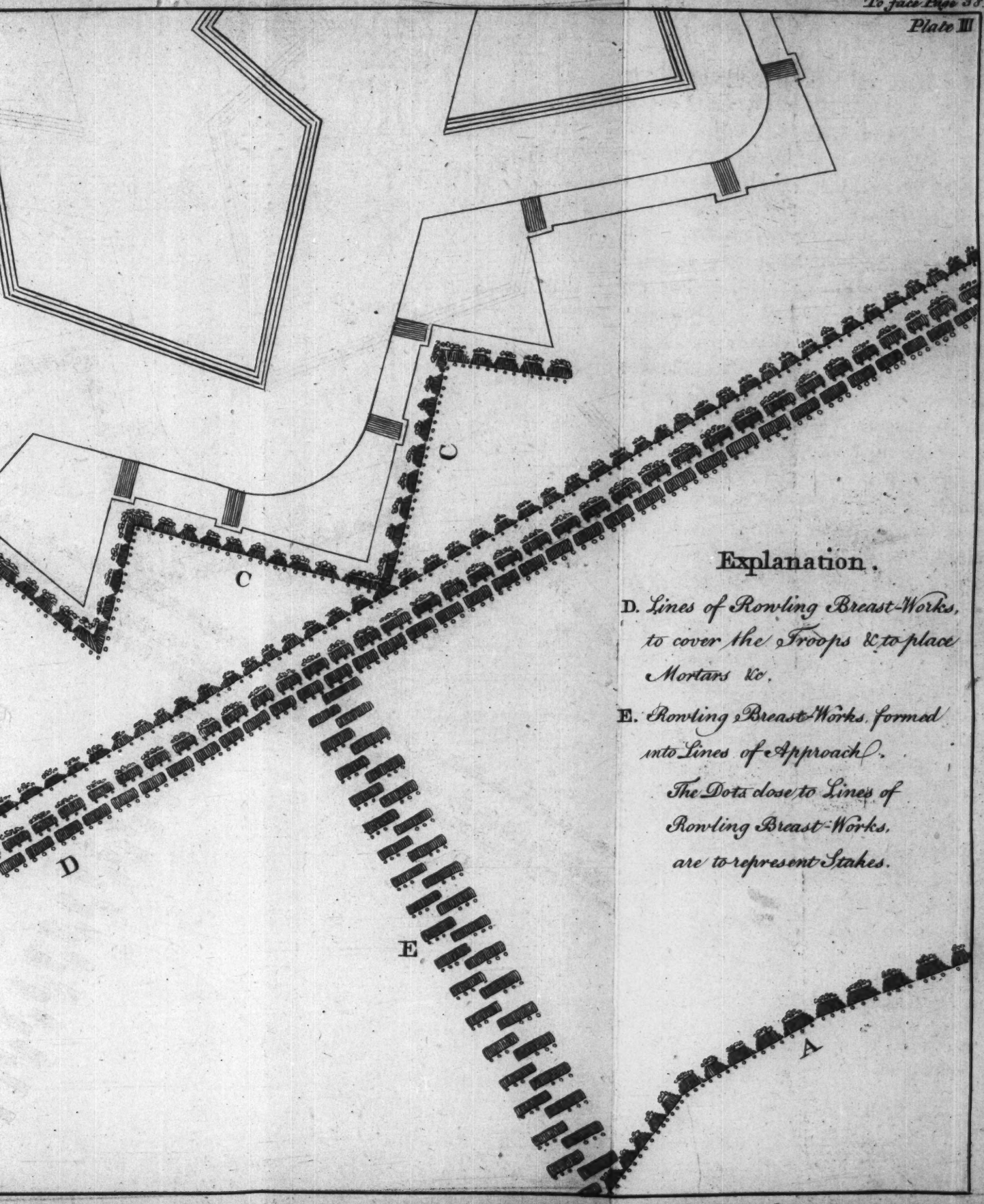

C
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D
B
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Scale 30 Fathoms in an Inch.

Plate III



Explanation.

D. Lines of Rowling Breast-Works, to cover the Troops &c. to place Mortars &c.

E. Rowling Breast-Works, formed into Lines of Approach.

The Dots close to Lines of Rowling Breast-Works, are to represent Stakes.


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Thus may as many Paſſages be made at the ſame Time as is neceſſary; but if the Bridges (deſcrbed in Chap. VII.) prove manageable, the Uſe of ſuch Bridges will be much the quicker Way to croſs Ditches.

It will eaſily be perceived that the foregoing Methods of attacking Places of Strength, require a great Number of Rolls of ſo great a Size as cannot be conveniently carried by Land, and the moving Bridges will be very cumberſome to hawl to any conſiderable Diſtance by land, not to mention the great Number of Cannon and Mortars propoſed in this Manner of attacking Places; all which renders it ſcarce practicable for an Army by land to attack Places in this Manner.

Nor will it be prudent, or adviſeable, for any Power that is liable to be attacked on the Sea by a ſuperior Force to attempt theſe Methods, except in ſome diſtant Part, for the great Number of Cannon and Mortars to be employed on Shore, and the Bridges, rolling Parapets, *&c.* will take up a conſiderable Time to imbark them, notwithſtanding the Troops can imbark in a very little Time, and thereby give a ſuperior Power more Time to arrive, and the Riſque of loſing ſuch a Number of Shipping as muſt always be employed in ſuch Enterprizes, and ſo many Cannon, Mortars and other Materials on Shore, *&c.* will be greater than the Proſpect of Advantage; eſpecially when it is conſidered that the ſtronger Power at Sea can, by the foregoing Methods, take the Place again in five or ſix Days.

It doth not require great Penetration to perceive the vaſt Advantage *Britain* has over all other Nations by being Maſters at Sea: I ſhall only give an Inſtance in this one Caſe; let it be ſuppoſed the *French*, or any other Nation, ſhould attempt the Methods here deſcribed, would not they run a great

Riſque

Riſque, and always be afraid of being ſurprized by our ſtronger Squadrons? can they lie upon the Sea ſecure and purſue their Operations as the *Britains* can? or can they, when they attack a Place belonging to *Britain* with Ships, promiſe themſelves, with any Degree of certainty, that they will not loſe their Ships and Troops, and every Thing they bring before the Place?

CHAP. IX.

Of fitting old Ships of War in a different Form after they have been condemned as unfit for Service in the common Way.

AS ſuch Ships are eſteemed but of ſmall Value when condemned, the only Way to make them uſeful afterwards, will be to fit them up with ſmaller Maſts and Rigging, and to contrive them ſo within that they cannot ſink, and by altering their Guns to a different Poſition, enable the Ships to carry them with greater Eaſe and Safety, and make the Ships much more formidable to batter Forts and Caſtles, which may be done by various Methods, of which take the following Example.

Bring on two or three very thick binding Strokes on the Outſide, about the Floor Heads, fore and aft, and ſecure them well, which will ſtrengthen the Bottom much; and if it ſhould ſo happen that the Ship ſhould come on Ground, will alſo keep her more upright and prevent Damage by her over heeling; then bring on two or three Strokes more of Clagging, to round the Bulge fair; in the next Place proceed to fix ſeveral Rows of ſtrong Eye-Bolts, fore and aft, through the Keelſen and Keel, and through the binding Strokes on each Bulge, well clunk through Iron Plates, let in juſt their Thickneſs

Thickneſs into the outſide of the binding Strokes; and there muſt be as many of theſe Eye-Bolt as will be thought ſufficient to bear the Weight the Ship will ſwim at; to each of theſe Eye-Bolts fix three ſtrong Chains of different Lengths, in Proportion to the Depth of the Ship, and to the Thickneſs of the Stratums of Materials that are to be put in to ſwim her by; after which hang theſe Chains perpendicularly up, and ſtop them tight faſt; then clear the Hold, take out the Pumps, and afterwards take in as much clear worked Shingle for Ballaſt, with ſome Chalk Rubbiſh to make it bed ſolid, to keep out as much Water as poſſible, and as will be ſufficient to ballaſt her, reſpect being had to the Weight of Rigging, Guns, *&c.* that is to be above Water, after the Ballaſt is in, which is to be laid fore and aft cloſe down to the Cieling, in ſuch a Manner as will anſwer her Trim for ſailing, when ſhe has Ballaſt ſufficient for Sea; make the Ballaſt very ſmooth aed level, then cover it all over with good Fir Planks laid acroſs, that will join cloſe to each Side of the Chains, that muſt be fixed in exact Rows acroſs the Ship, to which they may be ſecured, or kept down, by running ſtrong fore Locks, *&c.* through the Links of the Chains; next proceed to lay a Stratum of Cork, or ſome other light Materials, about ſix Feet high, ſo cloſe packed together as to leave as little Vacuity as poſſible; make the Cork plain at Top, and lay Balks of light Timber, fore and aft upon it, cloſe to each other, taking Care that the Ends of theſe Balks always butt in a Line with the Chains, for the better Oportunity of the ſeveral croſs Balks that are to come upon theſe fore and aft Balks, one on each Side the Chains, by which they are to be faſtned down; which done, lay great Weights upon the Bed of Timber, as Cannon, *&c.* or force of Screws, and after ſtanding

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ing to ſettle ſome Time, the Whole may be faſtened down together, by the firſt and ſhorteſt Chains.

The firſt Bed or Stratum of Cork and Timber being thus ſecured, proceed in the ſame Manner to fix a ſecond or third, faſtened well down with their ſeperate Chains, taking particular Care that the Butts of the fore and aft Pieces be well ſhifted, and the croſs Pieces be ſufficiently ſecured, and every Tier of Balks made as tight as the Buſineſs will admit of, to prevent the Water ſwelling too much in the Ship when it may happen to be let into her.

If the Cork lie in the Ships long, and thick muddy Water is often let in among it, in proceſs of Time the Cork will grow too heavy, therefore it may be proper to ſtow in the middle of the Ship fore and aft, upon the firſt Stratum of Corks, one Breadth of hollow Bodies, made like Caſks, but very ſtrong; theſe hollow Bodies may be proper to aſſiſt the Cork in ſwimming the Ship, and Experience will ſhew what is beſt; and ſhould it prove that the Hold will be moſtly taken up with the Courſes or Stratums of Cork, ſo that there will be little Room left for the Stowage of Proviſions, *&c.* a Vacuity or Room in the Midſhips may be made fore and aft, in the laſt or upper Courſe, or Stratum of fourteen or ſixteen Feet wide, water tight for that Purpoſe, and the Space between which and the Ship's Sides may be filled with Cork as near as poſſible to the Water Line, that the Ship will ſwim at when her lower Tier of Guns, which are all intended in theſe Ships, Stores, Proviſions, *&c.* are all on board, and a tight Deck laid over all, and the inſide Cieling for three or four Feet above the tight Deck made alſo tight, to prevent the Water

ſpanging up when the Ship heals by carrying ſail, rolling, or otherwiſe*.

As ſuch Ships are deſigned to lie before Forts and Batteries, which will be more fully deſcribed by and by, the next Care will be to contrive Defences for the Men on board them, which may be done in the following Manner, *viz.* contract the Breadth of every Gun Port nearly to the Diameter of the Gun, for as theſe Ships are chiefly deſigned to lie before Batteries, in ſuch Manner as to ſtop the Battery's Fire from other Ships paſſing on their off Sides, there will be little Occaſion for the Guns being laid in an oblique Direction. When got near the Place of Action, fix upon the Ship's Outſide, between every Gun Port, Quilts made of any cheap Matter that will not readily take fire, and will deaden a Ball much; I cannot at preſent think of a better Material for this Purpoſe than the feathery Part of Quills, cut as long as may be, not to ſpoil the Quil†, and Woollen as mentioned in Chap. V. which being wetted will hardly take fire; the Thickneſs of theſe Quilts to be ſuch that two or three Thickneſſes of them be as thick upon the Ship as to fill her Side out ſo far as the Muzzles of the Guns reach, when run out in order to be fired: Their Meetings muſt not be oppoſite each other, ſo that a Ball hitting upon the Joint on the outſide may

* As ſuch Ships will be lightly rigged, and need no more Men on board than will be able to navigate them, it is preſumed that by the Help of ſuch a Room and other Contrivances, ſix Weeks or two Months Proviſions may be ſtowed at once, and as they are only deſigned to go along with Fleets upon ſome Enterprize, they may be at every Opportuuity repleniſhed from the Fleet.

† The Tops of all ſorts of Quills are very ſtrong; if a Quilt were well made of them it would be very ſtrong; this Material may be had cheap, it being generally thrown away as not fit for any Service.

may find a Joint ſtraight forward; the Length of theſe Quilts about ſeven Feet, the Breadth equal to any Meaſure that three, four, or five, *&c.* will exactly fill each Space between the Guns, as likewiſe below and above every Gun; and between every Gun on the inſide, place a Number of thinner Quilts, one behind another, the Length of every one of theſe Quilts to reach nearly from Gun to Gun, and the Breadth nearly the Height between Decks; let them be faſtened looſely together at Bottom and Top, that every outermoſt ſingle Quilt may have Liberty to be puſhed back, but the Sides made as ſtrong together as the Quilts are in other Parts; at every Corner of the united Quilts make a ſtrong Nooſe to faſten ſtrong Ropes that are to hold the Quilts near the Ship ſide, by having a ſufficient Weight hung at each Rope's End below the Gun Deck, ſo as to hawl up or let down at pleaſure, and yield to any great Force, ſo that a Ball coming through the Ship's ſide, with the Splinters, may be catched in theſe Quilts, and if not confined there, may not do much Miſchief after. How this may appear to the underſtanding Reader, I know not, but as the Force of Cannon Balls are reſiſtable, their Force may be ſtopped, and when a Ball has forced its Way through the Quilts on the outſide, and through the Ship's Side, its Force muſt be greatly leſſened when it meets the inſide Quilt, which yields to its Force, and ſtops it in a gradual Manner.

Between the other Decks (for the higher theſe Ships are out of the Water, the better Muzzle or Defence they will afford to the Ships they are intended to cover) fix two Rows of ſtrong Stantions, fore and aft, fifteen or ſixteen Feet apart, and fill the Space between them and the Ship's Sides with any cheap Stuff that will deaden the Force of a Ball, and

not

not eaſily take fire; ſuch as Bags of Hogs Hair, coarſe hairy woollen Raggs, *&c.* which muſt all be wetted in time of action, for the better preventing of fire; and the upper Deck may likewiſe be made a ſafe Place for Men, by being fitted in the Manner laſt deſcribed.

A Ship thus fitted, will not only cover her Men extremely well in time of action, but has alſo this great Advantage, that, let never ſo many Shot go into her Bottom ſhe cannot ſink; nor need the Bottoms of ſuch Ships be caulked, it being evident they will ſwim* at all times alike, by the Materials put into them, and the Ballaſt in their Bottoms will make them ſtiff enough; however, to make the Ship more lively, and ſail the better with a Fleet, I would recommend the Bottom to be kept tight as long as it can; and the more ſo as it will have the great Advantage of being more wholeſome for the People.

CHAP.

* If any Diffidence ſhould ariſe, in regard to the Ship's ſwimming, (when fitted as here deſcribed) a Proof may be made by taking any ſmall Veſſel, fitted with Maſts, &c. and fit her up in the ſame Manner as here deſcribed; after which let the Water in, and try how low it will ſink her; then put in as much Weight in proportion to her, as the Guns will be in Proportion to the Men of War ſo fitted; then try what ſail ſhe will carry, and I make no doubt (if the Ballaſt be well proportioned at firſt) but ſhe will be as ſtiff to carry ſail, as Ships generally are; and it would be neceſſary ſuch like Experiment be made, to find out a juſt Proportion of Ballaſt to be put at firſt into the Ship's Hold; and would not be amiſs, if two or more Wells were contrived, from the gun Deck, to the Bottom of the Ship, to put in, or take out, more Ballaſt at pleaſure.

CHAP. X.

As the laſt Chapter hath treated on the making old Ships of War proper Ships to lie Broadſide on, to muzzle Forts or flanking Batteries, and cover the other Ships that paſs them, ſo this will treat of ſuch like old Ships of War, fitted up in a different Manner, to lye End on, and to batter Caſtles, Forts and Batteries, in the following Manner, viz.

IN Place of carrying two or three Tiers of Guns at their Sides, they are now to carry four or five Guns in a Tier, athwart Ships, according to the Size and Breadth of the Ship that is to be ſo prepared; firſt Rates may carry eight, ſecond Rates ſeven, and third and fourth Rates ſix of theſe Batteries, one above another, beginning the firſt Battery platform, cloſe forward upon the lower gun-Deck; though perhaps it may be found neceſſary to lower the fore Battery, two or three Feet below the lower gun Deck; the Foot of the next Parapet ten Feet* farther back, towards the Ship's Stern, and about five Feet higher than the firſt, and ſo on till the Length and Height of the Ship above Water, are filled up with ſucceeding Batteries, Here an Objection will immediately ariſe, How will the lower fore Batteries be able to fire, on account of the Ship's Bows, which muſt be in the Way of the Guns? To which it is anſwered, the Ships

* Though ten Feet is only allowed between the Parapet for Men to ſtand and load the Guns, the Guns will have ſufficient room to run under the Parapet next behind them, there being deſigned four Feet and a half in height, clear, between each Platform, and the under Side of the Beams that ſupports the Parapet and Platform next behind it.

Ships, for this uſe, may be ſo fitted, that when they arrive near the Place of action, their Bows and Fore-parts may be taken down ſufficiently low, and it will be neceſſary the Fore-maſt and Bow's-ſprit be taken out, if the Ship can be brought to her Station without them; which may be re-placed at pleaſure after the Action.

The next Thing to be contrived is a Defence for the Men, by having Parapets of about eight or ten Feet baſe, and ſix Feet high, before every Battery of Guns, and as the Top of each preceeding Parapet will cover two Feet at leaſt of the Foot of the next ſuceeding Parapet, few of the Enemies Balls can get under the Platforms to do miſchief there, and the Batteries cannot be enfiladed, as the Ship's Sides are not to lie to the Enemy; and the Parapet inclining aftward, ſo as to make the Angle at the Baſe about thirty Degrees, will give ſo great a Slope to the Parapet, that the Enemy's Balls (except ſhot from a very high Battery) will fall upon it with a ſmall Angle of incidence, and will conſequently fly upward, without doing much Damage, eſpecially if the Slope of the Parapet be faced with ſtrong and hard Materials.

The Platform, or Gun-deck, of each Battery, may be laid in ſuch a Manner that the Cannon may always have room to traverſe, and to recoil ſo far as to give room to load quickly, for though the Gun will have but about ten Feet clear behind the Parapets to ſtand in, yet the Deck on which ſhe ſtands being run at pleaſure under the next Gun-Deck, it being about four Feet and a half in height clear, will give room ſufficient for the Guns to recoil.

In each of the Embraſures, which are to be through the Parapets, a Madrier or Stop may be

fixed,

fixed*, ſo as to riſe up by the recoil of the Gun, and fall down again when ſhe is run out; ſo that the Men on board may fight under very good Defences, which will be a great Means to ſave the Lives of many brave Seamen.

It is not improbable that it may be found practicable for a firſt Rate to carry, if neceſſary, twenty or twenty-five Guns on each Side, additional to the forty on the 'thwart ſhip Batteries; and that other Ships in like Manner may carry a proportionate Number, according to the Size of the Ship; all which Guns, for the greater Eaſe and Safety of theſe Ships, may be carried in Tranſports to the Place where they are to be fitted for action.

The Parapets here mentioned may be thought too heavy for the Ship, ſo as to make her crank, but as the Guns are not be mounted at Sea, and there being no Top-maſts, Top-yards, *&c.* when the Guns are all on board, and the Ship all right, will make ſome amends for the Weight of the Parapets. Temporary, or falſe Decks, may be put over the Batteries on theſe Ships, to make convenient Decks at Sea, and when they are not in action.

I do not endeavour to give a particular Account of every minute Part of preparing ſuch Ships; I only aim at being ſo far explicit, as to be underſtood by Men of capacity and practice.

* Theſe Madriers may be ſo balanced by Weights, &c. that the recoiling of the Guns will eaſily hawl them up, having Pullies, &c. fixed for that Purpoſe, ſo that by this Contrivance the Men cannot be hurt by Muſket Shot; and it is poſſible to make them ſo ſtrong, and to fix it with ſuch a Slope, as to make the Ball that ſtrikes it glance upward, clear of the Men.

CHAP. XI.

Of ſmall floating Batteries, to batter an Enemy's Caſtles, Forts, &c.

FLOATING Batteries being ſo eaſily conveyed from place to place, eſpecially in the prime of Summer, and the *French* Coaſt lying ſo near to *England*, *Britain* may ſend ſo great a Force before any one place on the *French* Coaſt, or any other neighbouring Coaſt, that the greateſt Force that is upon any one Spot of ground ſhall in no caſe be able to reſiſt it; I do not mean that all this mighty Power is to conſiſt of great Ships of War, but only of a ſufficient number of Sea fighting Ships, to convoy and protect the floating Batteries at Sea; for many of them, eſpecially thoſe of the firſt Line, will carry their Guns ſo low, that they cannot be fought at Sea, except the Sea is almoſt ſmooth; neither are the Guns to be mounted upon theſe low Batteries at Sea, except in fine Weather, when there may happen to be occaſion for them to aſſiſt againſt the Enemy's Ships, *&c.* The Guns in the Veſſels of the ſecond and third Line, will be a ſufficient Height above water, to be fought at Sea.

Floating Batteries may be conſtructed in the following Manner.

To conſtruct the low Batteries for the front Line, build Veſſels with very flat Floors, and with proportionable Lee-boards*, like the reconnoitring

 Boats,

* According to the Idea I have of theſe Lee-boards, they will not only make Veſſels ſail well upon a Wind, but alſo in ſome meaſure prevent their rolling.

Boats, (Chap I.) about forty Feet broad, and about ſeventy-five or eighty Feet long, and very low; ſo that their Gun-decks (which is all the Decks they are to have) may be ſo low, that the Muzzles of the Guns be not more than one Foot above the Water †, when fitted for action; but when theſe floating Batteries are croſſing the Sea, they will be a tollerable Height above the Water, having neither their Guns on board, nor the Water let into the Well they are to have.

The Holds of theſe floating Batteries muſt be ballaſted and filled with Cork, or other light Material, in every reſpect as the Ships mentioned in the Ninth and Tenth Chapters, except that theſe Veſſels are to have a circular Well, the whole Breadth of the Veſſel, and down to her Keelſon, to contain a circular Body to ſwim in it; upon which ſwimming Body a proper number of eighteen Pounders are to be planted, ſuppoſe eight, which will be moved round at pleaſure, (the Body on which they are placed ſwiming within the Ship) and fired through narrow Embraſures in a good Parapet fixed upon the Veſſel's Deck, and the Men ſtand ſafe behind the ſwimming Battery, to load the Guns under its cover at one Side, while the Guns are firing on the oppoſite Side toward the Enemy.

The Veſſels which are to form the ſecond Line of Battery, which is to lie behind the firſt Line, and which are conſtructed in the ſame manner, ſave that

* Theſe Veſſels being deſigned to carry a round floating Battery within them, they muſt be as broad as poſſible, in a moderate Length, to be able to keep the Sea, and contain a ſufficient quantity of Cork, or other light Material, to ſwim them, like the Ships deſcribed in the Ninth and Tenth Chapters.

† Other Veſſels being to ſhoot Balls over theſe Veſſels, it will be proper to have them as low as poſſible, that the other Veſſels may not be too high.

that they may be deeper in the Water than the Veſſels in the firſt Line, ought to have larger Guns, and their Gun-decks ſo high above the Water, that their Guns may ſafely ſhoot over the Veſſels in the firſt Line.

A third Line of Battery, in like Manner, may be placed behind the ſecond, and in ſome Caſes a fourth Line of Battery may likewiſe lie behind the third; for Inſtance, when the firſt Line of Veſſels can lye ſo very near the Enemy's Works or Defences as to admit of a good Space between every Line of Battery, and the rear Line of Battery lie ſufficiently near: Secondly, when the Enemy's Defences are high, or upon a riſing Ground, ſo that the Guns upon the Water muſt point much above the level to batter them. When as many Lines of Batteries are laid againſt a place as can do good Service, lay a good Number of Veſſels with Mortars, at a proper Diſtance, behind all the Lines of Batteries.

That Nation who are Maſters at Sea, may make uſe of many Contrivances to overcome Places of defence upon an Enemy's Coaſt, and deſtroy their Ships in their Harbours; but at preſent I ſhall only give my Ideas of two other kinds of Sea-Batteries, which upon trial may, in ſome Caſes, prove very ſerviceable.

The larger of theſe two ſorts of Batteries are alſo to conſiſt of flat-floored Veſſels, conſtructed in the ſame Manner, length and breadth as thoſe laſt mentioned, ſave that in place of Batteries ſwimming round within the other Veſſels, here the whole Veſſel is to be turned round upon the Water, (alternately changing Sides towards the Enemy) by means of ſuch a Contrivance in the Ends of the Veſſels, that the Enemy can neither ſee the Contrivance, nor ſhoot the Men that work the Veſſel round, and the ſame Contrtrivance will force the Veſſels to go ei-

ther a head or a ſtern, though but ſlowly, whither water is deep or ſhallow.

To make this Contrivance, Openings on each Side the Keel muſt be in the Veſſel's Bottom, as near both the Ends as can be, and built up a little higher than the Water-line the Veſſel will ſwim at; the 'thwart Openings to be ſix or ſeven Feet long, on each Side of the Keel, and a Foot, or more, wide; there muſt alſo be Openings lengthways, fore and aft, the Opening aft on the contrary Side of the Keel to that forward; theſe Openings to be of the ſame Length and Breadth with the 'thwart Openings. Hang two Lavers, or dipping Oars, of a convenient Length, in each Opening, the lower Ends of which muſt be thin, ſomething like a common Oar Blade, to be pulled edgeways through the Water; near the low End of the dipping Oars *, fix on Fins, that by means of a Hinge will cloſe together at the fetching of every Stroke like a thin Wedge, and extend directly, and hold much Water when the Stroke is given, the Ends of the Fins that opens and ſhuts being well ſtayed to the Edge of the Oars, poſite the Hinges.

The Guns are to lie in an Embraſure without any room to traverſe ſideways, but at liberty to ſhoot high or low; it is ſuppoſed every Gun will fire when the turning of the Veſſel brings it right againſt the Object; each Gun is to have a Spring or Weight, ſo as to recoile but a little Way; here is to be no Opening or Space between the Gun-carriages, all are to be ſolid the whole Length of the Guns and Carriages, and alſo four or five Feet Space between the

* The dipping Oars in the 'thwart Openings will turn the Veſſel round, and the dipping Oars in the lengthway Openings will give the Veſſel head or ſtern Way; when there is not above fifteen Feet Water, long Poles put to the Ground, through theſe Openings, will have more Force than dipping Oars.

the Guns Muzzles, and the outſide of the Ship, where Men are to ſtand and load the Guns, when that Side is turned from the Enemy, being covered by a Work raiſed upon the Space between the Breaches of the Guns mentioned in the next Paragraph.

Between the Breaches of the Guns on one Side of the Veſſel, and the Breaches of the Guns on the othe Side, is to be a Space of about nine or ten Feet wide, fore and aft, clear between the Breaches of the fore and aft Guns, well covered from the Enemy's Fire; the Deck or Floor of this place being at leaſt ſix Feet below the Top of the Guns, there muſt be a Step ſet up to raiſe the Men who fire the Guns: The Top of the Guns muſt lie nearly level with the Top of the Parapet, (this Parapet is formed by making a Part of the Breadth of the Veſſel ſolid) which is to be about fifteen Feet thick, on each Side of the Veſſel, ſtuffed with Matter that is moſt proper to reſiſt the Force of Cannon-Balls, with a Contrivance to wet the Materials in the Parapet, to prevent its taking fire. A low Veſſel of forty Feet broad, and eighty Feet long, may carry five or ſix twenty-four Pounders on each Side, with three pointing forward, and three pointing out aft, with Amunition, *&c.* and not draw above four Feet Water: Before theſe Veſſels enter upon Action, their Maſts and Rigging ought to be taken away.

The ſmaller floating Batteries are likewiſe to be flat floored, and to mount only four Cannon each, and draw about two Feet and a half Water. Theſe ſmall Batteries may be ſerviceable in many Caſes, as they will be proper Veſſels to go very near the Shore, and in ſome places get under the Defences, that only the flanking Cannon, if any be, and muſquetry can bear upon them, which the floating Bat-

teries may ſoon ſilence, as they will be very greatly ſuperior in Number of Guns; and their Balls flying much upward, will do great Damage to the Enemy's Defences; and if the Defences are Stone, will drive Splinters of ſtone upward, which will do great Execution in the Place.

CHAP. XII.

HAVING in the foregoing Chapters briefly deſcribed ſeveral Inventions, that I think may at preſent, or hereafter, be uſeful to my Country, and having in ſome degree ſhewn the uſefulneſs of ſome of theſe Inventions, I ſhall now proceed to ſhew the Utility of old Ships of War, when fitted as deſcribed in the Ninth and Tenth Chapters: The Ships deſcribed in the Ninth Chapter are adapted to lay with their Broadſides on, to muzzle Forts or Batteries, that other Ships, not ſo fitted, may paſs by with greater Safety; they are alſo proper, if at any Time found neceſſary, to muzzle flanking Batteries, by laying between them and the other Ships, fitted as deſcribed in Chap. X. whilſt they are battering any ſtrong Fortification a head, and alſo to preſerve Attacks by Sea, upon Batteries aſhore, from being flanked by Batteries erected for that Purpoſe. When ſuch Ships are well conſidered in all theſe Reſpects, I think they will appear to be of ſuch Conſequence and Service to *Britain*, as will induce ſome great Men to beſtow a few Thoughts upon them; for, ſuch Ships cannot be ſunk by Cannon, nor by coming aground, till they are daſhed in Pieces; and the Men are well defended by the different Defences, as mentioned in Chap. IX. beſides, when the muzling Ships are once laid in their Stations, all the Men, ſave two or three to look out in their Turns, may preſerve themſelves where they think proper; eſpecially

eſpecially if it ſhould be found that the fighting of their Guns would be of little Service. It will be eaſily conceived that all the Enemy's Fire cannot force theſe Ships from their Stations; and if they ſhould attempt to burn, or cut ſuch Ships adrift, there are ſufficient Ways and Means to render theſe Attempts fruitleſs, by being moored with Chains, or having Frigates near, or other armed Ships; beſides, each Ship may have a Tier of Guns and ſmall Arms to defend her.

Damage in the Maſts and Rigging muſt be expected; however, as much of theſe as poſſible may be taken away before they are ſent to their Stations, and ſhould their be a Neceſſity to bring ſome Ships off their Stations before the Buſineſs be done, they may be towed off with as little Riſque as they were brought on to their Stations, of which hereafter.

The Enemy's Batteries will be effectually muzzled all the Time ſuch Ships lie before them; theſe muzzling Ships cannot effectually ſecure the Rigging of Ships paſſing under their Cover, as the Enemy's Shot may fly over their Hulls, unleſs the muzzling Ships can lay very near the Enemy's Batteries at high water, ſo that their Guns muſt be pointed very high to fire over them, or that a great Number of Muſqueteers, well fenced in the Ships, aſſiſted by the Ships Cannon, can drive the Enemy from their Guns

In the next Place is ſhewn the Utility of Ships fitted as deſcribed in Chap. X. which will, in ſome Meaſure, illuſtrate the Utility of the Ships deſcribed in Chap. IX.

It will appear (when the Conſtruction of theſe Ships is rightly underſtood) that by having Ships fittted according to the Deſcription in Chap. X. more than double the Force of what can be brought now by Sea, may, by this Method, be brought againſt

gainſt Caſtles, Forts, and Batteries, that defend the Entrance into Harbours, *&c.* for a Ship having all her Guns pointed forward, ſo that as many Guns, to ten or twelve, can in the Breadth of the Ship be fired at once, againſt an Object, (the Ship lying with her Head toward it) as can be fired at once if the Ship lay with her Broadſide to it; and as the Breadth of three Ships can lay in the Length of one Ship, and if the Length of the Bows-ſprit be conſidered, four Ships may lay in the Length of one, with Room to ſpare; it is evident beyond Diſpute, that more than double the Number of Guns can be fired from four Ships, lying with their Ends to the Object, (fitted according to Chap. X.) than can be fired by Ships lying with their Broadſides to the Object, admitting there are as many Ships to bring before the Place to lay End on, as there is Room for, cloſe before the Caſtle, Fort, or Battery.

The Number of Guns in the Length of a Ship's Side, will ſeldom be found in Fortification, above nine in one Tier, and in the Breadth of a Seventy Gun Ship, not above three, except there is in the Fort a high and low Tier of Guns, which indeed there are often, at the Entrances of Places of Importance; ſuppoſe there are two Tier, then there will be only eighteen Guns in the Length, and ſix in the Breadth, of a ſeventy Gun Ship.

A ſeventy gun Ship, fitted according to Chap. X. will (lying End on) be able at leaſt to bring twenty or twenty-two Guns to bear againſt ſix in a Battery on ſhore, ſuppoſing two Tiers in the Battery, which is four to one, againſt the Fort or Battery. I am ſenſible that many Objections may be made againſt the Utility of the Ships fitted as deſcribed in the Ninth and Tenth Chapters, yet I know of no Objection but what may eaſily be anſwered.

Objection I.

Objection I. The Ships fitted as deſcribed in Chap. X. will be crank, and will ſcarce ſtand upon their Legs, eſpecially to carry ſail, the after Batteries with many Cannon being ſo very high above Water.

Anſwer. Theſe Ships are not to carry their Guns mounted at Sea, except in fine Weather, when going from a Road or Bay; perhaps two or three Miles, to ſilence Batteries, *&c.* at the Entrance of Harbours, *&c.* and as ſuch Ships will not carry above half the Number of Cannon they uſed to carry, before they were fitted in this Manner; and though the two after Batteries are high, the Batteries forward are lower, conſequently has not above half the Weight to carry above Water they carried before, by which it appears, ſuch Ships will not be much altered as to their ſailing, but will be as ſtiff to carry ſail, as other Ships of War, though moſt of their Guns are mouted.

Objection II. The Batteries aft having to fire over all the other Batteries forward, above one hundred and fifty Feet in length, will greatly incomode the Men, and endanger the firing the Ships, as the Wadds will not fly clear of them.

Anſwer. All the Wadds being made of woolling, and wetted properly for Service, will neither hurt the Men, nor fire the Ship.

Objection III. The Enemy's Fire will rake the Ship fore and aft, and do much Execution, having the whole Length of the Ship in a Line to fire along

Anſwer. The Slope of each Parapet takes its Riſe about two Feet below the Level of the Top of the Parapet next before it, by which Means the Men are covered from the Enemy's Fire, ſomewhat better than if there were only one Battery, and one Parapet to fire at, as the Enemy's Fire will be diverted

verted amongſt ſo many Batteries; and twenty Guns will deſtroy one or two Parapets aſhore before* ſix Guns firing from a Fort can deſtroy five or ſix Parapets in a Ship, there being only five Feet in height of each Parapet, expoſed to a level Shot, the fore Battery excepted; and as the great Talus, or Slope of the Parapets, will cauſe the horizontal Balls that ſtrikes on them to graze, and perhaps leap clear of the Ship; and if any Balls ſhot from a high Battery go in below any of the Batteries Parapets, they muſt go in amongſt Cork and Water, or where they can do little or no Harm.

Objection IV. Though there are Breaſt Works to cover the Men and Guns, if the Ships lie end on, there is nothing to cover their Broadſides againſt the Enemy's flanking Batteries.

Anſwer. There is the ſame Defence for theſe Ships Broadſides, as other Ships now have for their Broadſides; yet Ships are deſcribed in Chap. IX. that are to cover with their Broadſide the Sides of the Ships that are to batter end on, by lying with their Broadſides againſt thoſe flanking Batteries, which may be ſo ſituate, that Ships cannot at that Time lay with their Heads toward them.

Objection V. In five Parapets, one behind another, there are ſo many Embraſures, one behind another, that the Enemy's Shot cannot miſs of hitting ſome one

* If there ſhould be exceeding great Batteries aſhore, as ſeveral Tiers of Guns, and Parapet behind Parapet, to the Number of five or ſix, or more, as is very poſſible to have them ſo in ſome Places, the battering Ships may be relieved as often as is neceſſary, by others taking their Place; but the low floating Batteries will, I think, be found propereſt to attack ſuch Batteries, as the proper Direction of their Shot flying upward will graze, and leap from one Battery to another, and do much more Miſchief than Balls flying in a horrizontal Direction; beſides, the ſmall floating Batteries drawing ſo little Water, will very probably get under the Batteries, that their Guns cannot bear upon them, eſpecially the high Battery's Guns.

one or more every Fire, and thereby do much Miſchief.

Anſwer. Though five Rows of Embraſures are one Row behind another, a Ball can do little more Harm by going through the formoſt, or any other Embraſure, than if there were but a ſingle Battery, for whatever Embraſure the Ball goes through, it will go under all the Men in the Batteries behind that Embraſure, where it can do little Harm; beſide, the Madrier contrived to fill the Embraſure by the Recoil of the Cannon, and to clear the Embraſure when the Cannon is run out, will add conſideraby to the Safety of the Men; add to this the Unequality between twenty Guns in a Ship at Sea, againſt ſix, or perhaps but two or three Guns in a Fort aſhore, and that the ſix, or perhaps two or three Guns aſhore (as is before mentioned) have five Breaſt-works or Parapets in the Ship to demoliſh, while the twenty Guns in the Ship have only two, or perhaps but one Breaſt-work or Parapet on ſhore to fire at, and two or three Guns to ſilence. There are other great Advantages on the Side of the Ships fitted as above, *(i. e.)* no Time need be ſpent or any Riſque run, in letting go Anchors to bring the Ships properly up; in going before Caſtles, Forts *&c.* the Ships running in ſhore to engage Forts or Batteries with their Heads toward them, there is nothing to be done but to begin firing as ſoon as the Ships are within Gun Shot; the Ships may run bump aſhore (firſt letting go an Anchor a ſtern, where a Windlaſs muſt be fix'd below) on a riſing Tide with their Heads toward the Forts or Batteries if the Ground is good, and let fall from within their Quarters* ſtrong Balks of Timber, well ſhod

* A ſtrong Caſe or Coffin muſt be made a convenient Diſtance from each Side of the Keel, and two or three Feet below the Ship's

ſhod with Iron, to go into the Ground, to hinder the Ship's caſting athwart in a gentle ſhore Swell, as mentioned in Chap. III.

Objection VI. So many Cannon firing ſo near over Mens Heads will ſtun the Men and make them unfit for action.

Anſwer. This Objection has ſeemingly ſome Reaſon in it, but I have obſerved the Concuſſion made by the Exploſion of a Cannon diverges very little; a Cannon fired in a narrow Embraſure of Earth, whoſe Sides were about a Foot and a half clear of the Gun's Bore, the Concuſſion made but little Impreſſion upon the Sides of the Embraſure, and what Impreſſion appeared it was but a very ſmall Diſtance before the gun, and the Impreſſion was leſs upon the Bottom of the Embraſure, though the Bottom was as near the Gun as the Sides. From theſe Obſervations it may be imagined a man may ſtand ſafely ten or twelve Feet Diſtance before a Cannon, provided the Crown of his Head is about two Feet below the paſſing Ball; or the Men in the Batteries need only ſtep under the Parapets next behind them, and ſtay there about half a minute, or the time the guns next behind them are firing, and no Harm can come to them from their own Guns.

A few Experiments upon the Head of a Dog or other Animal, will clear the Point, and fix exactly how near a Man's Head may be to the Muzzle of of a Gun when fired, and receive no uncommon Harm.

The Guns in Forts and Batteries aſhore that lie low, are ſuppoſed to do the greateſt Damage to Ships,

Ship's Heal; in which Caſes or Coffins muſt be hung ſtrong heavy Oak Balks, ſhod with Iron, to let drop into the Ground as ſoon as the Ship touches forward.

Theſe Balks may be eaſily let down and hove out of the Ground when there is Occaſion, by a Purchaſe fixed for that Purpoſe See Chap. III.

Ships, but thoſe Guns will be of little Service againſt the Ships here deſcribed, as doth appear in the Courſe of this Work, which is another great Advantage theſe Ships have over Batteries aſhore, and it is, I think, very plain theſe Ships have double the Advantage of the Sea-fighting Ships againſt the Forts and Batteries aſhore, and when the Advantage ſhipping has by this Method over Forts and Batteries aſhore is known, the preſent Fort will not engage ſhipping upon ſuch unequal Terms.

If I remember right, it has hitherto been allowed that Ships of War, getting within a Cable's Length of a Fort, have the Advantage of common Forts, if ſo, great Things may be hoped from Ships being able to carry double that Force in the ſame Space, *(i. e.)* in the Length a ſeventy gun Ship takes up before the Fort (whoſe Broadſide is only thirty-five Guns at moſt) three ſeventy gun Ships, and if the Length of the Bowsſprit is conſidered, four ſeventy gun Ships may lie end on, in the Length of one ſeventy gun Ship, each of which can fire at leaſt twenty Guns as quickly, and with more ſafety, than a Ship can fire her Broadſide; here is eighty Guns in the place of thirty-five, or perhaps but thirty-three; and Forts will be laid under greater Diſadvantages, by this Scheme, againſt eighty Guns, than they have hitherto been under againſt thirty-five Guns; for inſtance, the low Batteries aſhore at the time the Tide is high will be of little Service againſt theſe Ships; and as it is very evident that Ships have with their preſent Force often ſilenced Caſtles and Forts, and then have gone into Harbours and deſtroyed Shipping, *&c.* It certainly will be allowed that Ships which not only have more than double the Force they have hitherto had, but alſo have other conſiderable Advantages,

tages, will with reaſon diſregard and deſpiſe the Force of Caſtles and Forts on ſhore*; and the Nation who are Maſters at Sea, will alſo be Maſters of all the Harbours in *Europe*, until every Power, who has Harbours and Ships to ſecure, has erected ſtronger Defences, and is at a great Expence to maintain them.

* It is allowed a firſt Rate Man of War's preſent Force is about four or ſix Guns to one that Common Batteries have in the ſame compaſs, but a Ship's Motion has been ſpoken of by ſome in a manner tending to inſinuate a Belief that Ships always have ſo great a Motion, they cannot hit a Battery, ſave ſome chance Shots, and therefore Batteries on the Shore has (through the Ship's Motion only) ſo great an Advantage over Ships, they may ſink every Ship that dare to come near them.

Now as there is only the Motion Ships has to object againſt their having the Advantage of Batteries, there cannot be any Objection when Ships has not a Motion to hinder their hitting the Batteries, and it is known, beyond Contradiction, that in the generality of Summers, there are three or four Months in which Ships may, for the moſt part, lay before Batteries at the Entrances of Harbours, *&c.* and not have ſo much Motion as will make a practical Gunner ſhoot uncommonly wide of his Mark.

As to keeping the Battery's Guns ready to pour all their Shot into the Ship when ſhe comes near and oppoſite, this the Ship may very eaſily avoid, as Batteries may be deſtroyed by oblique firing, and a Ship in many Caſes need not come where all the Battery's Guns can bear upon her.

There are many ſtrong Batteries that two Ships in fine weather may deſtroy with little Damage to themſelves, by oblique firing, the Ships lying at the extream Ends of the Battery, where few of the Battery's Guns can bear upon them; Ships has great Advantages when they are manageable, and can be laid in any Station.

From common Knowledge, and from what has been ſaid, it is ſelf-evident that if it can be contrived to conſtruct Ships that will carry double the Number of Guns in the ſame Compaſs, no Batteries, yet in being, can be able to withſtand them.

CHAP.

CHAP. XIII.

Of the Means Britain has to take or demoliſh an Enemy's Sea-ports, and deſtroy their Ships in Harbour.

HAVING in the foregoing Chapters treated of ſeveral Inventions that thoſe who are Maſters at Sea may make uſe of, in order to maſter an Enemy's Sea-ports, and deſtroy their naval Power, I will in this Chapter treat of the Application.

In order to make it appear in a proper Light, that *Britain* has the Means to demoliſh an Enemy's Sea-port Towns, Forts, and Batteries, and conſequently be Maſter of the Harbours, and may deſtroy the Enemy's Shipping, let it be ſuppoſed, a ſufficient Number of Ships, with low floating Batteries, *&c.* are prepared according as deſcribed in the foregoing Pages, and the Fleet ordered to go into *Breſt* or *Toulon*, and take or deſtroy the *French* Ships there.

If any Advantage is to be gained by unexpectedly and ſuddenly attacking the interior Force at *Breſt*, *Toulon*, or any other Sea-port; I mean if any Advantage can be gained by ſea fighting Ships running, at their firſt appearance, directly paſt the enemy's Forts and Batteries, into their Roads and Harbours, (being covered in their running paſt the Forts and Batteries by muzzling Ships) and attacking their Ships in their Roads and Harbours; and the muzzling Ships, that covered the ſea fighting Ships in running in, to lie before the Batteries that are within, if neceſſary, while the ſea fighting Ships take or deſtroy the enemy's Ships.

The Ships that are to muzzle Batteries muſt be well fenced; and when ordered to duty muſt carry

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as few Men as poſſible, and have very little Rigging, with as many Chains inſtead of Ropes as can be uſed; and if they are to lay before Batteries muſt only have their lower Maſts and Sails, the Yards to be let down upon Deck when the Ships are got to their Stations.

Having a good Opportunity, the muzzling Ships and ſea fighting Ships ought to ſail forward in their proper Stations *(i. e.)* a cloſe line of muzzling Ships on each Side the ſea fighting Ships, if the Entrance is narrow, and Batteries on each Shore, in order to receive the Enemy's Fire from their Forts and Batteries, with a ſufficient Number of muzzling Ships in the Van, to be ready to lay before the Batteries that are ſituated to rake the Lines of Ships while in the narrow Entrance; (for without doubt there are ſtrong Fatteries to enfilade, as much as poſſible, every Courſe and Channel leading into *Breſt* Road, *Toulon*, and other principal Harbours in *France)* as the Ships whoſe Holds are filled with Cork cannot be hurt by coming aground, unleſs upon a high ſharp Rock, when it is falling water, or except there is a Sea to break them to pieces, the muzzling Ships may make bold, eſpecially in a flowing Tide, and ſteer near in ſhore, and ſo run cloſe to the Bateries, which about the Time of high water will effectally muzzle them; and as by loſs of Maſts, *&c.* it may be expected the Sails of many of the muzzling Ships will be rendered almoſt uſeleſs, therefore a ſtout Towline muſt be faſtned from Ship to Ship, one Tow-line between every two Ships; the End paſſing into each Ship about eight or nine Feet, or a ſufficient Depth, under water, to be clear of the Enemy's Shot, near the Stern-poſt, and at the ſame Depth under water, as near the Ship's Cut water as may be; ſo each Ship has the End of

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a Towline Forward, and the End of a Towline a-baft, to ſlack out or hawl in at pleaſure.

When muzzling Ships are either to ſail along with other Ships to cover them while paſſing Forts and Batteries, or to lie before Batteries, they muſt be as cloſe ſtem to ſtern, as the ſmoothneſs of the Sea will permit them; and if any of the muzzling Ships are diſabled, which can only be in their Maſts and Rigging, the headmoſt Ships not being diſabled in their Rigging will both tow the Ships a ſtern off, and keep them in their Stations, by Means of the Towlines before mentioned, for no Damage in the Hulls need be feared; but as the headmoſt Ships are as liable to be diſabled in their Rigging as the other Ships, they cannot be depended upon to tow, or any otherwiſe aſſiſt the Ships a ſtern; and as the muzzling Ships muſt get as near the Batteries aſhore as poſſible, otherwiſe they cannot cover the Rigging of the ſea fighting Ships. It is not very practicable for the ſea fighting Ships to tow the muzzling Ships, ſo as to anſwer any very good Purpoſe, which makes it abſolutely neceſſary to be prepared, and able to make the headmoſt muzzling Ships go a-head, and keep their Stations, though diſabled in their Rigging; There may be ſeveral things contrived for this Purpoſe, though the Enemy's Shot may render moſt of them unſerviceable; in ſpeculation there appears a Contrivance which will anſwer this End; but Experience muſt confirm it, by making an Experiment according to the following Manner: Let each of the headmoſt muzling Ships have one or two very large Cannon, or a proper mortar or two pointing forward, (perhaps it may be found neceſſary to caſt Cannon for this particular Service) wtih Chains fix'd to Balls to be fired out of the Gun or Mortar, a proper Anchor being faſtened to that End of the Chain which hangs out of the Gun or

Mortar, and a Towline bent to the Chain at the Anchor, and quoiled ſo as not to entangle when the Anchor is thrown out a head by the Gun or Mortar being fired: Though it cannot be expected an Anchor of any conſiderable weight can be thrown out to a uſeful Diſtance by this Method, yet upon Trial it may be found that Anchor after Anchor, of a ſmall weight may be thrown out, by which the Ships may be warped paſt Forts and Batteries; but if the muzzling Ships are only to lay before Forts and Batteries till other Ships paſs, they may at any Time eaſily be hawled off, either a head or a ſtern, by Towlines bent together for this Purpoſe, and the Ships having the End with them*.

Thus the Lines of Ships are to proceed in cloſe order, always keeping, if poſſible, the muzzling Ships againſt the Enemy's Cannon, while paſſing within gun-ſhot of the Enemy's Forts and Batteries; and when the Ships are got near the Enemy's Batteries in the Harbour, *&c.* the muzzling Ships are to lay before thoſe Batteries, if need be, while the ſea fighting Ships are engaged in deſtroying the Shipping.

The Ships that are to batter with their Ends on, and the low floating Batteries, to follow cloſe a ſtern of the Ships that are running paſt the Batteries, and begin firing upon the Forts and Batteries as ſoon as poſſible; and if their is ſufficient Room, the Forts and Batteries ſhould be attacked at the ſame time the ſea fighting Ships are running paſt, or rather ſooner; but of this hereafter.

If it is apprehended little or no Advantage is to be gained by a ſudden or unexpected Attack, the following

* It is ſcarce worth mentioning that Ships may carry the End of a Towline any Diſtance, by having the Coil on board, and letting the rope go properly out, as the Ships move forward.

following Method may be taken to ſilence the Enemy's Forts and Batteries, ſo that ſea fighting Ships may ſafely run paſt them into Harbours, Roads, &c.

Admit a Deſign is formed to deſtroy Ships in Harbours whoſe Entrances are well defended by ſtrong Batteries upon the Shores, and it is thought moſt adviſeable to ſilence thoſe Batteries before the ſea fighting Ships attempt to enter (though covered by muzzling Ships) to perform that Service.

Being arrived conveniently near the place of Action, in the prime of Summer, take the Opportunity of low Water falling ſoon in the Morning, to order the floating Batteries, Bombs, &c. to get before the Place deſigned to be attacked, a while before low Water, (if the Tide doth not ebb too far from the Batteries aſhore) and in the following Order:

The ſmall Batteries that draw about two Feet and a half of Water are to move forward in the Van, and form the firſt Line before the Place; and if there are ſtrong flanking Batteries, muzzling Floats, that draw no more Water than the ſmall floating Batteries, prepared for that Purpoſe, muſt be laid before them; ſuch muzzling Floats are ſo eaſy to conſtruct, if what is ſaid in the foregoing Chapter be conſidered, that it would be ſuperfluous in this Place to give a Deſcription of them. The firſt Line of Battery, compoſed of ſmall floating Batteries, muſt be followed in proper Order by as many Lines of larger floating Batteries as can lay ſufficiently near, and ſafely fire over each other to good Purpoſe; and as the firſt Line will probably get very near * to the Batteries on ſhore, it may be ſup-

* I am little acquainted with the *French* Manner of making Forts and Batteries to defend the Entrances into their Ports, but if the Forts and Batteries I have ſeen at home are examined by

poſed four Lines can bring their Guns to bear, and that every Line at each End is about a quarter of a Mile longer* than the Batteries on ſhore, if the Situation will admit; theſe Lines of Battery to be followed by as many Bombs as can lay behind the rear Line of Battery, and play to good purpoſe.

If, notwithſtanding all this Force, the Batteries on ſhore, by well directed Balls, diſable many of the floating Batteries, and oblige them to hawl off at about two Hours Flood, which is proper Time for battering Ships, deſcribed in Chap. X. to advance, with Bombs under their Sterns, as before mentioned, and make a freſh Attack upon the Forts and Batteries, it being reaſonable to imagine the floating low Batteries has not left the Forts on ſhore in a very good Condition; I think the ſhattered Batteries on ſhore cannot long reſiſt ſo great a Force as the battering Ships, deſcribed in Chap. X. but, for the ſake of Illuſtration, let it be ſuppoſed,

The Batteries on ſhore be wonderfully ſtrong, and regularly ſupplied with freſh Men, and alſo Guns as ſoon as any are diſmounted, ſo that after ſome

by proper Men, it will be foond that the low floating Batteries here deſctibed, may, in the laſt Hour of the Ebb, and the firſt of the Flood, do much Miſchief to the Defences, and the Forts and Batteries aſhore cannot bring any conſiderable Number of Guns to bear upon them; and low Veſſels, properly filled with Mortars, Coe-horns, &c. may alſo do much Miſchief with a good deal of Safety.

* The Lines of Battery here ſpoken of, being conſiderably longer than the Batteries they oppoſe, will by their Length have an Advantage, both in regard to their Number of Guns, and the oblique Direction of the Shots fired from the Ends of the Lines, for by an oblique Direction the Balls have a better Chance, not only to diſmount the Enemy's Guns, but by croſſing the Shots made from the Batteries in the Front will do greater Damage to the Defences.

ſome Hours battering the Ships* are alſo obliged to hawl off; if this ſhould be the Caſe, which is very improbable, ſeeing the Force of theſe Ships is ſo great, the low floating Batteries by this Time (the Men being refreſhed, and the places of the diſabled Batteries ſupplied by others) will be ready to advance again as at the firſt, and begin a freſh Attack. Thus may the battering Ships, and alſo the low floating Batteries, alternately relieve each other, at a proper Time of tide, till no Defences on ſhore, yet made or invented, can reſiſt them any longer. And

Veſſels can arrive ſo unexpectedly before places ſituated by the Sea, that it cannot be in the power of any Government to know with any degree of certainty, what Place will be attacked, and to provide every place with a Garriſon uncommonly numerous, and a double or treble number of Cannon, would be too great an extra Expence perhaps for any Nation to bear, even but for a few Years; therefore it is very improbable, if not impoſſible, that any Place will make ſo great a Defence as is here imagined; and if it is poſſible to make ſo great a Defence as is here deſcribed, yet they will be ſilenced after they have done all they can, as the floating Batteries can be ſo eaſily relieved, and new Batteries laid before the Place time after time, as often as there ſhall be occaſion.

This will be reducing our Opperations by Sea, againſt an Enemy, to ſome certainty at a ſmall Expence, compared to the Expence and Riſque of keeping ſtrong Squadrons on an Enemy's Coaſts to watch their Motions, the Effect of which is ſomwhat uncertain.

* It is ſhewn in Chap. XII that theſe battering Ships lying with their Ends on to batte, in the Length of a Ship are more than double the Force of a Ship's Broadſide.

That *Britain* has the Means to do any poſſible Thing by Sea, is evident from the great Number of Seamen now in the royal Navy; and it is well atteſted there are full as many left for other Employments as can find entertainment in the Merchants Service; as for Materials for building and repairing Shipping, *Britain* itſelf affords much good Timber and Iron, *&c.* and has Money to purchaſe any quantity of other Materials that can be wanted; and there need be no want of Shipwrights if every Shipwright in his Majeſty's Dock Yards were allowed a Servant.

I will not undertake to enumerate the Advantages that will accrue to the Nation who is ſtrongeſt at Sea, by putting the Schemes here laid down into practice, and by being Maſters, not only of all the Harbours in *Europe*, but in every other Part where any Advantage appears; and not only deſtroy the naval Power of *France* for the preſent, but limit that Power to a certain Number of Ships of War for the Time to come. This would be a Bleſſing to all *Europe*, if the Nation whom God has bleſſed with the ſtrongeſt naval Power continue to fear God and love their Neighbours, in taking away many of the Cauſes of Contention, and conſequently prevent the ſhedding of much chriſtian Blood; for if the Accounts I have read and heard be true, there have been few blooody Wars in *Europe*, amongſt Chriſtians, in the two laſt Centuries, that have not been either begun or prolonged by the Intrigues of *France*; therefore if *Britain* at this Time* will enter heartily upon deſtroying the naval Power of *France*, and the other Powers of *Europe* countenance the Deſign, to prevent *France*, as much as poſſible, from ever being any conſiderble maritime Power for the future. This would certainly

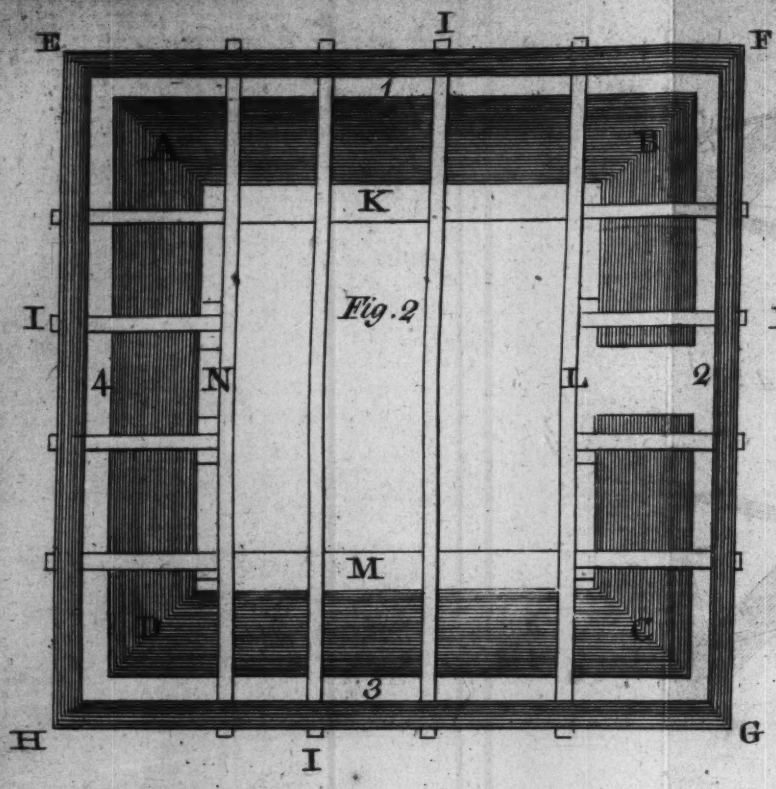
* Written in the Year 1758.

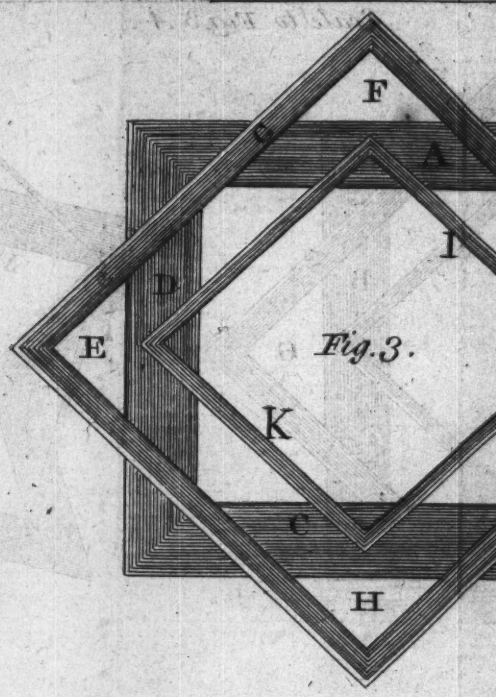
ly be the greateſt Good done to Mankind, by mortal Men, ſince the World began.

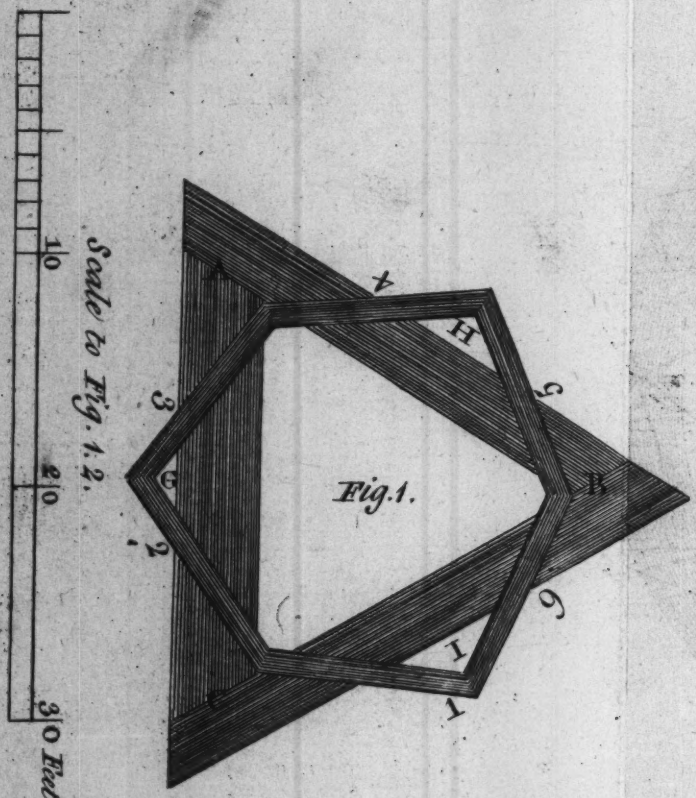
There might be given a long Account of the reſtleſs Spirit of the *French* Nation, and their breaking through all Treaties, not regarding Men's Lives, nor the Diſtreſſes of the Innocent, but obliging Nations to arm in their own Defence, which has been the Cauſe of a great Effuſion of chriſtian Blood, and the Diſtreſs of many Thouſands of innocent People; but as all that I can ſay on this Head iswell known, it would be an uſeleſs Digreſſion to enlarge upon that Subject in this Place.

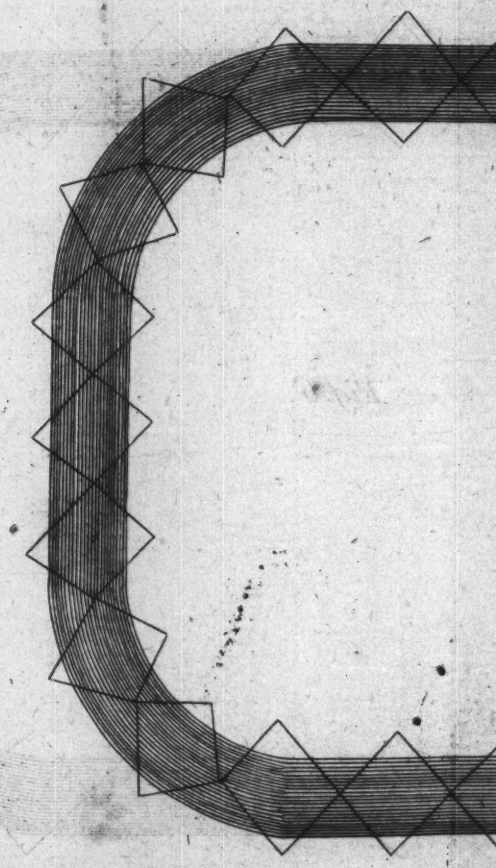
It being the *Britiſh* Trade that chiefly ſupports and ſupplies the *Britiſh* Power, therefore *Britain* ought always to look upon every Encroachment upon her Trade, by a powerful Rival, as greatly dangerous, not only to her Laws and Conſtitution, Liberty, and Property, but to her being a Kingdom.

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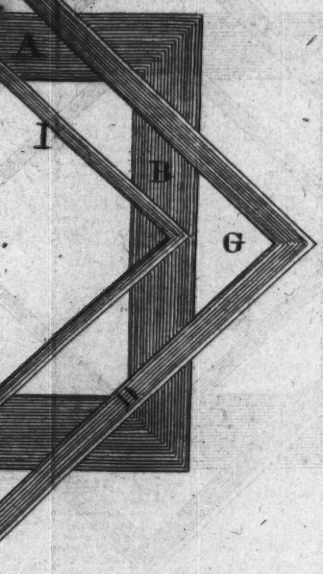

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Scale to Fig. 1. 2.



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Scale to Fig. 3. 4.



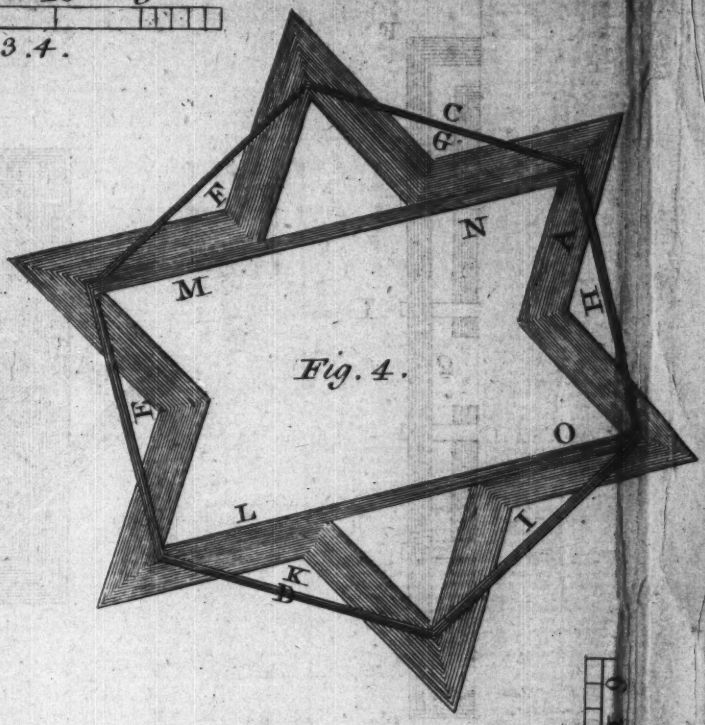


Fig. 4.

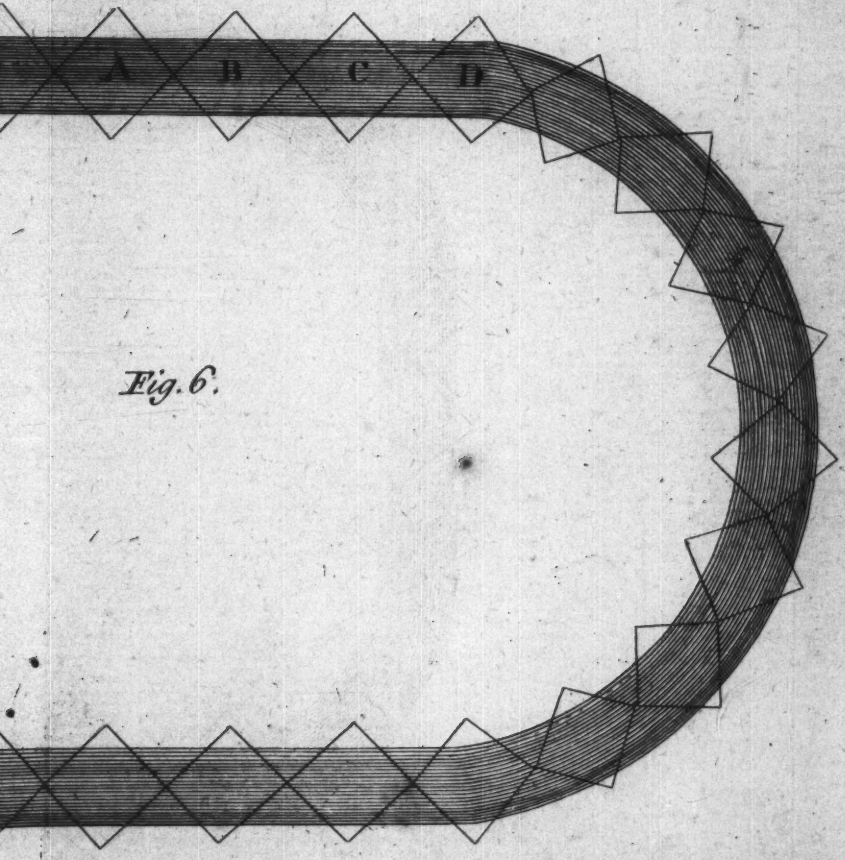
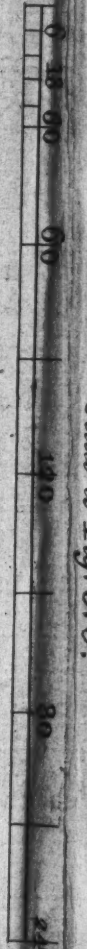


Fig. 6.



Scale to Fig. 5. 6.

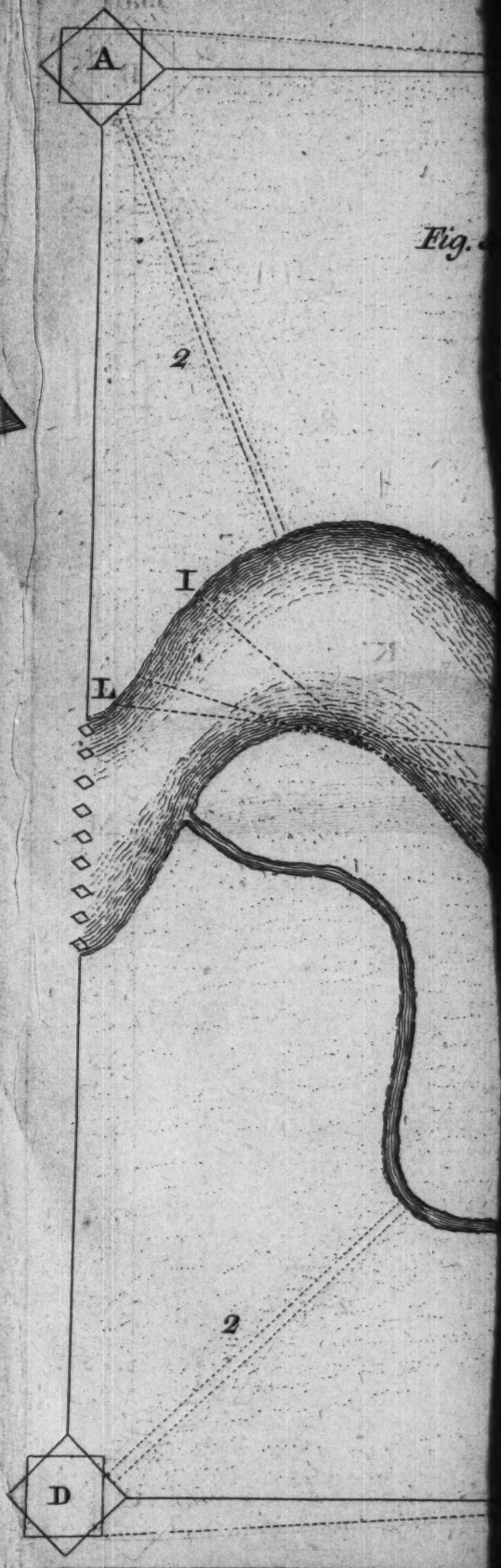
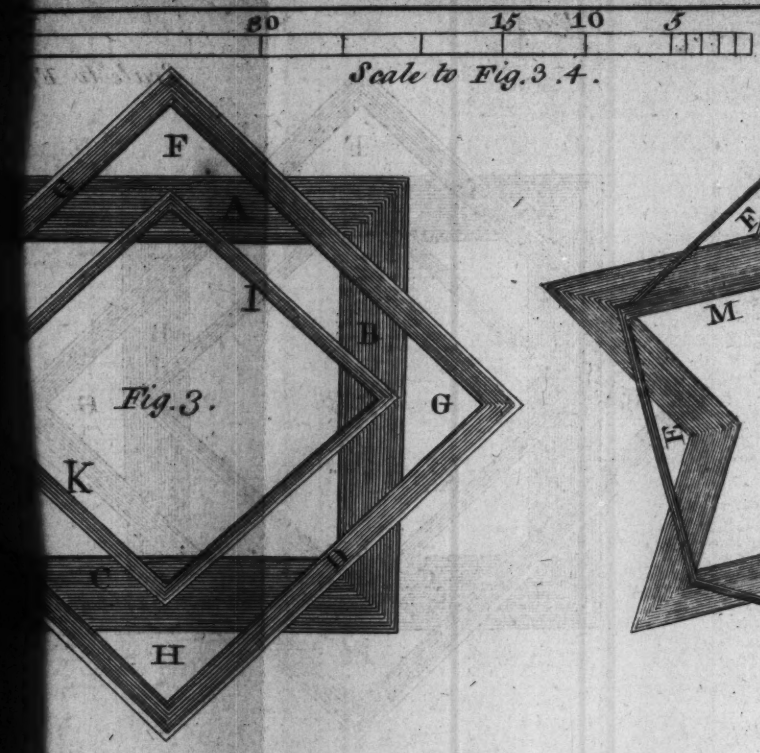


Fig.



Scale to Fig. 3. 4.

Fig. 3.

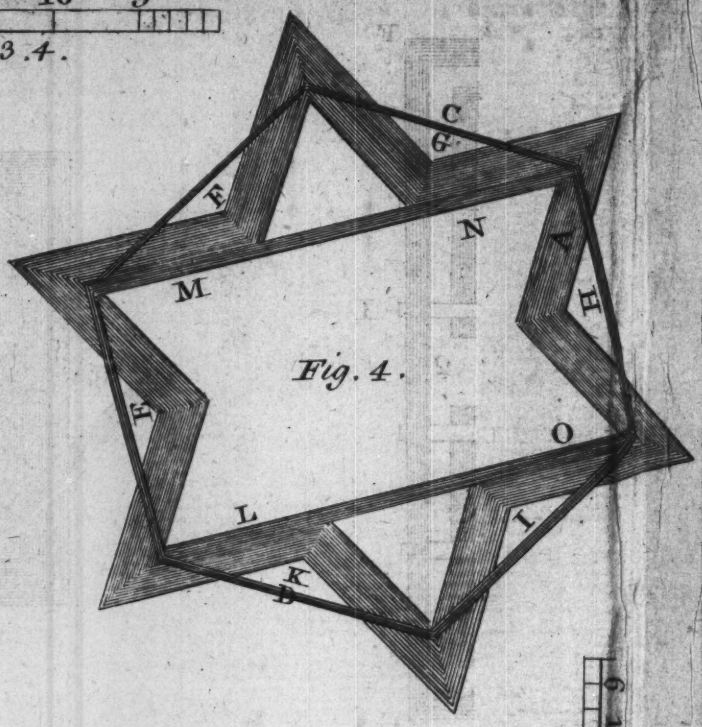


Fig. 4.

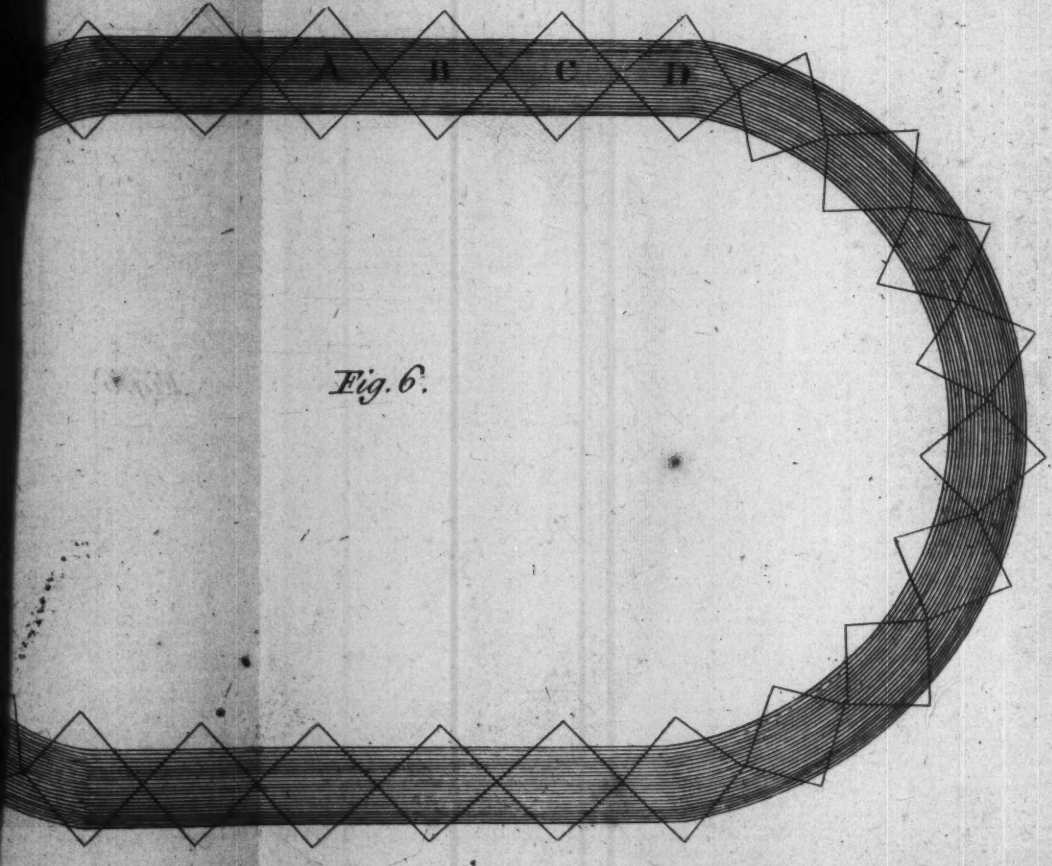


Fig. 6.



Scale to Fig. 5. 6.

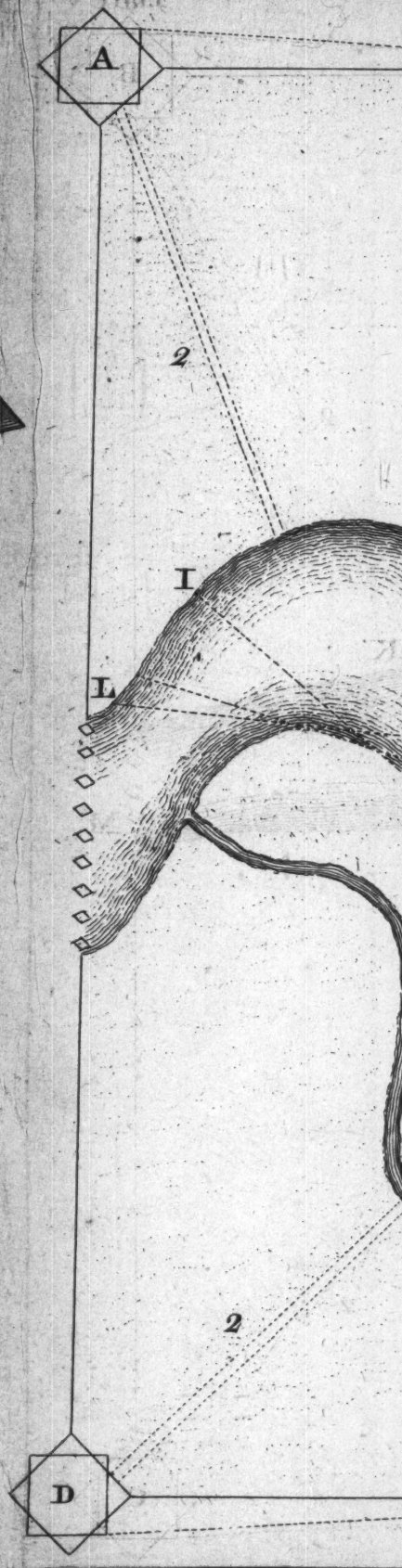
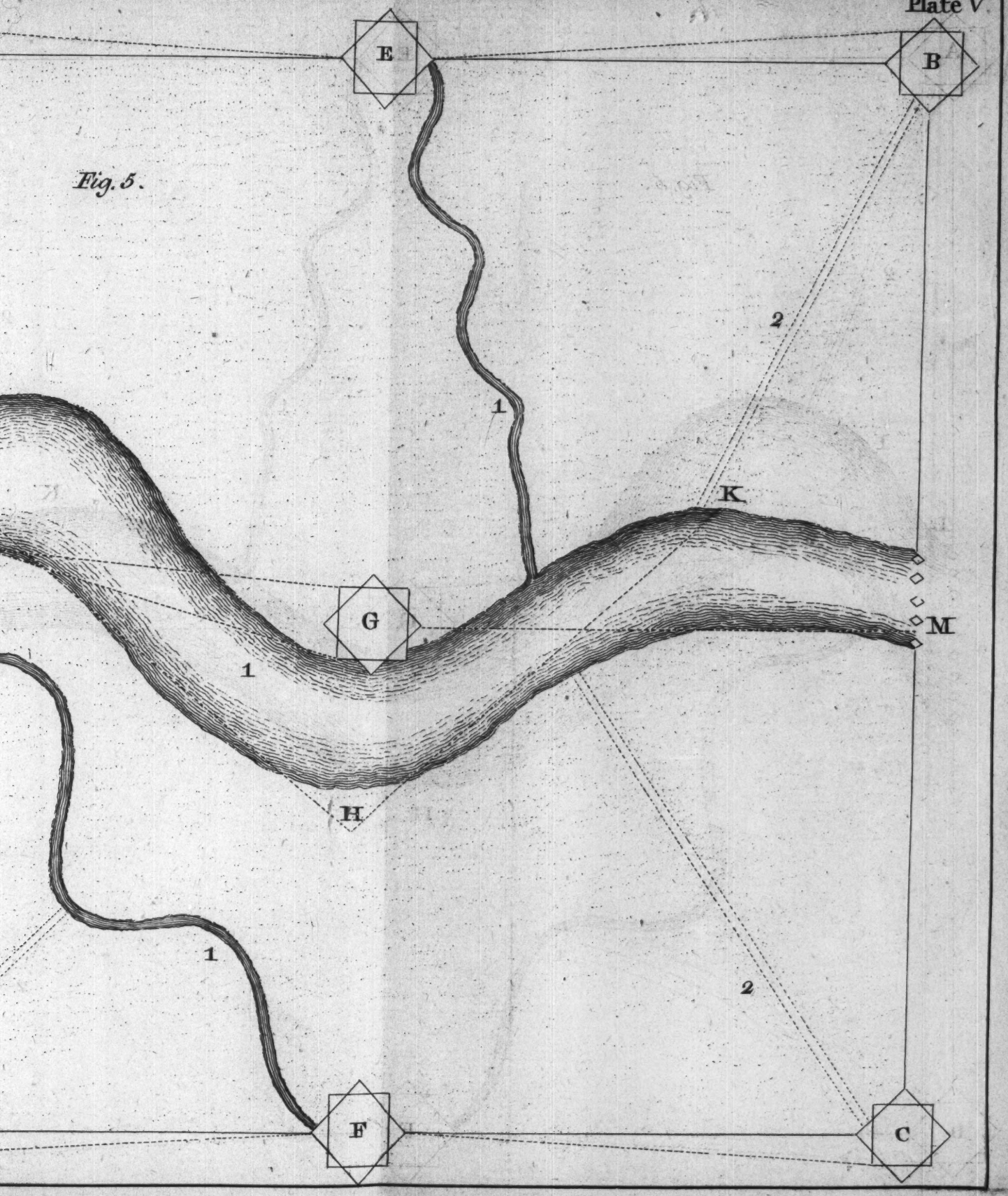


Plate V



THE BRITISH MARS.

PART II.

CHAP. I.

Of Fortification.

AS the Art of fortifying Houſes is uſeful in many Caſes, eſpecially in civilizing a ſavage People, and making Plantations amongſt them, I will in this Chapter ſhew ſeveral Methods of building dwelling Houſes that cannot eaſily be taken without Cannon; the Art of fortifying ſmall Places is called Fortility, and the Places ſo fortified are called Fortlets, or Fortins.

This ſort of Fortification was much uſed in the North Parts of *England*, before the Union of the two Nations, for the Inhabitants upon the Borders frequently plundered each other, taking away Sheep, Cattle, Horſes, *&c.* even in time of Peace; this made the People on the Borders think of ſecuring their Property, by building ſtrong Houſes, many

of

of which are yet ſtanding in the northern Parts of *Northumberland*. But,

As thoſe People knew little of Fortification, they onyly built their Houſes of Defence a little ſtronger than common Houſes, with Spouts above the Doors, to convey hot Water, *&c.* upon any one that ſhould attempt to break or burn the Doors; ſome of theſe Houſes has a Place at the Top of the Gavel End, or Pitch of the Roof, right above the Door, projected upon ſtone Corbels, from where they probably threw Stones, *&c.* upon thoſe who came near to break the Door; they alſo laid a Heap of large Stones, or built a ſmall Houſe with ſtrong Walls, a little Diſtance from the Door, to prevent any Thing of the nature of a battering Ram from forceing the Door,. Theſe Houſes are divided into a low and high Room, by great Beams covered with Rice or ſmall Wood laid acroſs them, over all which are laid a conſiderable Thickneſs of Earth, to make a Floor; they ſecured themſelves in the upper Room, and there Cattle, *&c.* almoſt every Night in the lower Part, eſpecially if any Tidings came of the Approach of the Moſs-Troopers, for ſo they called the Men who generally came to plunder. That thoſe Houſes were of great Service appears from the great Number of them, there being few old Villages near the Borders, that has not one or two, or more of ſuch ſtrong Houſes; and if Fortility were well improved, and properly put in execution, it would prove a very conſiderable Security to the *Britiſh* Settlements in *America*, eſpecially the Settlements moſt liable to be attacked by Parties of Indians; for very little more Labour and Expence is required to build a Fortin, or Fortlet, than is required to build a common dwelling Houſe, and three or four Men may defend a proper conſtructed

ſtructed Fortin, againſt a conſiderable Number of Indians, or even regular Troops, without Cannon.

PLATE V. Fig. 1. *Conſtruction of an equilateral Triangle Fortin.*

A, B, C, the ground Plan, which may be raiſed any convenient Height above the Level of the Ground, ſuppoſe eight Feet, or one Room in height, ſixteen Feet, or two Rooms high, *&c.*

1, 2, 3, 4, 5, 6, the Plan of the upper Part, which well defends the Triangle under it, through the Places marked G, H, I; Care muſt be taken to raiſe the Points A B C that Men cannot get upon theſe Points; the Entrance to be through G, H, or I, in Time of Danger, with a Ladder, as mentioned in the Deſcription of Fig. 2.

Fig. 2. *Conſtruction of a Square Fortin.*

A, B, C, D, the Plan on the Ground, E, F, G, H, a Parapet, Muſquet proof, ſix Feet high, its Baſe ſupported by Timber, as I I I I, ten Feet high from the Ground; but if it is required to have the Houſe three Rooms high, the Wall A B C D to be the Height of two Rooms; 1, 2, 3, 4, the Place where the ground Plan is defended; the Door to enter the Houſe to be about ſeven or eight Feet high from the Ground, having a broad ſtep Ladder, in manner like a Draw-Bridge, to be drawn up every Night, or when any Danger is apprehended; K L M N the Walls of the upper Room or upper Story, on which the Roof is built; the Roof and the Space, A B C D, to be covered with Earth, that Hand-Granadoes, or Fire, may do no Miſchief there, if thrown by an Enemy.

The Wall of the lower Part of theſe Fortins ought to be from four to ſix Feet thick, according to the ſtrength of the Material they are built with, and

and if it be poſſible they muſt be built with Materials that cannot be ſet on fire, as alſo ſhould every other Part of the Outſide, if the Materials are to be had at a reaſonable Expence; if ſuch Materials are hard to be got, the upper Parts may be built of Timber, caſed with Boards or Slabs of dead Sap, for dead Sap will not burn itſelf; but if Lime can conveniently be got to caſe the upright timber Work with a ſtrong Coat of Plaiſtering, that will preſerve the Timber from fire, and alſo endure the Weather, it will do better; if the Roofs of ſuch Buildings are covered with Boards or Shingles, they may be well turfed, when any Danger is apprehended, but the Turf ſhould be thrown off when there is no Danger of an Attack, for if the Turf is continued upon the Roof, and Water get through, the Boards or Shingles under the Turf will rot very ſoon.

Fig. 3. *A ſecond Method to conſtruct a Square Fortin.*

A, B, the ground Plan, conſtructed in all Reſpects as A B C D in Fig. 2; C, D, a Parapet with Angles, projected over the middle of the Walls, upon the ground Plan, which Angles form the Spaces E, F, G, H, through which the Faces of the Walls may be well defended; K, I, the upper Story, or Seat of the Roof; as to the Door or Entrance, ſee the Deſcription of Fig. 2.

Fig. 4. *Conſtruction of a Fortin Star.*

The Parapet, C, D, make a Defence to every Front of the Star, as E, that there is no need of Openings in the lower Wall to fire through; the Door or Entrance is through the Opening E, in Time of Danger, with a Ladder to let down and hawl up at diſcretion: See the Deſcription of Fig. 2.

2. L, M, N, O, the Walls of the upper Story, and Seat of the Roof.

The principal Part in making Settlements, are, firſt and above all, to fix upon a proper Spot of Ground for a Plantation, near a River or Brook, or at leaſt where is a ſufficiency of Water; and if the Situation is near a treacherous Neighbour, a particular Regard muſt be had to place the Fortin or dwelling Houſe, as far as poſſible from any Hill or other Place, behind which Men may approach the Fortin unſeen, and conceal themſelves till a proper Opportunity offer, to ſurprize it; and if the Fortin or dwelling Houſe is by a River, as G, Fig. 5, it ſhould be ſo placed that as great a Diſtance upon the River as can be, both upward and downward, is ſeen from the Fortin; and it may be proper to erect a tall Pole upon the Top of the Fortin, to hoiſt a Flag, or a Light upon, with a Convenience to get up to its Top, to look out, *&c.*

Fig. 5. ſhews how any of the Figures, 1 2 3 4, in Plate V. may be adapted to defend a Plantation, or Space of Ground, and alſo ſecure the Owner and Family, from almoſt any Number of Men without Cannon.

Suppoſe G and H, Fig. 5, are Fortins upon the Brink of a River, it is evident H commands the River no further than I and K, but G commands the River from L to M, therefore G is the better Situation in reſpect to commanding the River, and as Muſquets will kill Men at the Diſtance of three hundred Yards, the Fortin G will defend a Piece of Ground ſix hundred Yards ſquare, and if the Fortin is properly conſtructed, and defended by eight or ten active Men, it is hardly poſſible to take it without Cannon, while Victuals and Amunition laſt in the Fortin.

Admit

Admit four, ſix, or more Families agree to have their Plantations lie together, and build Fortins that will not only defend each other, but can alſo defend their Plantations.

Fortins for four Families, as A, B, C, D, Fig. 5. placed three hundred Yards apart, ſo that they can well defend each other, will have near one hundred and ſixty-eight Acres of Plantation, within Muſquet ſhot, which they can well defend; and if it is thought each Fortin has a ſufficient Defence for itſelf, they may be placed ſix hundred Yards apart, and have near two hundred ninety-eight Acres within Muſquet ſhot.

Fortins for ſix Families, as A, E, B, and D, F, G, Fig. 5. being placed three hundred Yards apart, will have near two hundred and twenty-four Acres within Muſket ſhot, which the Fortins can well defend, and likewiſe will defend each other; and if it is thought proper to place ſix Fortins ſix hundred Yards aſunder, they will have near four hundred forty-ſix Acres of Ground within Muſquet ſhot, and ſo on in proportion, as more or fewer Families have their Plantations lie together.

In any Place where it may be neceſſary for many Families to dwell together, a Fortification againſt ſmall Arms may be formed, by building Houſes with their Angles meeting together, as A, B, C, D, *&c.* Fig. 6. ſo that the other Angles form Redans all the way round the Town; in Time of Danger the Horſes, Cattle, Sheep, *&c.* may be ſecured in the Space of Ground incloſed and defended by the Houſes.

The Roofs of theſe Houſes being one continued Roof round the whole Town, ſo as the Roof will hang or project a good way over the re-entering Angles or Coyns of the Houſes that meet together,

and

and ſo form a good Defence for the re-entering Angles, and add much to the Defence of this ſort of Fortification.

There may be as many Gates or Entrances through the meeting of the Angles or Coyns of the Houſes as is neceſſary; and the entering into the Houſes, turfing the Roof, *&c.* in Time of Danger, to be as mentioned in the Deſcription of Fig. 2.

It will be ſuperfluous to trouble the Reader with Arguments to prove that Houſes, built in the Order as Fig. 6, will not coſt more than if ſuch Houſes were built in any other Order or Situation; neither need any thing be ſaid to prove the Advantages of ſuch a Diſpoſition of Houſes, the Advantages being evident, eſpecially in ſuch Countries as *America*, where the Planters are not ſafe with reſpect to their Neighbours.

CHAP. II.

EXperience has fully proved that the preſent Fortifications cannot long preſerve Cities and Towns, againſt a numerous and well provided Army; nor ſtop its Progreſs, ſo as the Advantages of ſuch Fortifications are ſuperior, or even equal, in many Caſes, to the Expence of building and maintaining them, a few Places of particular Situation excepted. And,

As ſo many eminent Men of great Experience, in ſo many Ages, have endeavoured in vain to render the Advantages of a Fortification equal to thoſe of the Attack; I think it may with reaſon be imagined impoſſible, without adapting an entire new Method of Fortification: But whether a new Method of greater Advantages can be invented is a

Queſtion

Queſtion not eaſily determined; for ſo long as the Beſiegers have it in their Power to bring as great Numbers of Cannon, Mortars, &c. againſt a Place, as they pleaſe, and can erect Barteries with as reſiſting Matterials as the Batteries of the Place are of, no Fortification, that a reaſonable Man will be at the Expence of, can be built by the common Methods of Fortification, and in a common Situation, but what may ſoon be taken.

Having conſidered that the firſt great Step toward taking a fortified Place, is the ſilencing the Beſieged's Fire to ſuch a Degree, that the Beſiegers can carry on their Works with tolerable ſafety, and erect their Batteries ſufficiently near the Defences of the Place. And

Having alſo conſidered, that notwithſtanding the Beſiegers has the Advantage of a much ſuperior Fire to that of the Beſieged, if any practicable Method can be found to prevent the Beſiegers from diſmounting the Beſieged's Guns, Mortars, &c. Places may hold out much longer than they generally do at preſent, and coſt much more Time and Expence to get Poſſeſſion of a fortified Place.

It doth not appear to me impoſſible to erect Batteries whoſe Guns the Beſiegers cannot diſmount any other way but by Mines, which in a watery Situation may alſo be prevented; and ſuch Batteries may likewiſe be built in a dry Situation, that the Beſiegers will find extremely difficult to blow up, eſpecially thoſe erected in the Body of the Place.

In order to gain theſe Advantages, Embraſures, Guns, Carriages, &c. muſt be made of a new Conſtruction; and I hope I am able to demonſtrate that by altering or making new Batteries in the Fortifications already built, ſome conſiderable Advantages

Advantages will be obtained, on the Side of the preſent Methods of fortifying.

As to the new Method of fortifying, herein attempted, the Ideas are very much different from any that have yet been publiſh'd, or put in Practice, that I know of; the Largeneſs of the Baſtions, Flanks, &c. or the Number of Outworks, are but little depended on in this Method, for Defence; it is here attempted to ſhow how a Fortification may be built that will not require ſo many Troops to defend a Place, as the preſent Fortifications require, and yet make a better Defence; and that a ſmall Place, defended by a Hundred, or two Hundred Men, ſhall coſt an Enemy, either many Men, or much Time to take it; and notwithſtanding I have ſpent much Time in making Models and conſulting Enquiries on the Subject of Fortification, I can ſay with much Truth, that I have no particular Intereſt of my own to ſerve, by the Improvement of Fortification; ſave the Satisfaction I may have in being inſtrumental in procuring to thoſe who are peaceably inclined, a Security againſt the ambitious Views of the Diſturbers of Peace.

As the Materials here propoſed are expenſive, the Batteries muſt be as ſmall as poſſible, to anſwer the Purpoſe; a Surface, or Plan, about equal to ſeventy Feet ſquare is ſufficient to make a ſtrong Battery, if built with the Materials here propoſed, andcontain ſeveral Tiers of Guns.

What appears the worſt to overcome, in the Manner of fortifying here propoſed, is, the Smoke of the Guns in the cover'd Batteries, which not only hinders the People in the Batteries from ſeeing round them, but renders it impoſſible for Men to continue in cloſe Batteries, to fire the Guns any conſiderable Time; but the Batteries here propoſed, are in a Degree open behind, and may have freſh

Air injected, to prevent the Smoke from becoming intolerable to thoſe who are appointed to work the Guns.

A Town has generally many Perſons in it who are of little Uſe in its Defence, but by different Contrivances every Perſon that can do any thing, may find Employment in the Defence of a fortified Place; admit a ſquare Battery (of ſix Guns on each Front) erected according to the Plans 1. 2. 3. Plate VI, with the Materials before mentioned; the Imbraſures little wider on the Outſide, than the Guns Muzzles will go through; Bomb-proof above, and Vents, or Openings, in proper Places, eſpecially one in the Middle behind the Guns, of thirty, or forty Feet ſquare; the Guns, (in ſuch a Battery as this,) being fired but a few Times, will fill the Place with Smoke, notwithſtanding the Vents and Opening in its Middle of thirty or forty Feet Square; ſo that no more firing can be there till a conſiderable Space of Time after; in which Time an Enemy may gain great Advantages: This being the only Reaſon Caſe-matted Flanks are not made in late built Fortifications, tho' they are of the greateſt Utility, if they could be kept clear of Smoke; and it appearing to me very practicable that the Perſons, who are otherways uſeleſs in the Defence of a Place, may inject Air into any Battery that has proper Vents for the Smoke to fly out; ſo that the Guns in ſuch Batteries, as mention'd above, may be fired with as little Difficulty, from the Smoke, as the Guns in an open Battery can be fired in calm Weather.

In order to keep a cloſe Caſe-matted Battery tolerably clear of Smoke, make a Bomb-proof Place under Ground, or in ſuch a Situation that the Beſiegers Guns and Mortars cannot demoliſh it; this Place muſt have Rooms one above another, as many

as are ſufficient to hold and work ſo many Bellows as will blow a Blaſt ſufficient to drive the Smoke out of the Battery; the Bellows to be placed with their Muzzels in the Center of the Room, with Ropes to go from the Levers that work them through the Arch or Floor into a Room below, where Men unfit for Arms, Women, great Boys, &c. are to pull at the Ropes and work the Bellows, all the Muzzels of the Bellows to have Valves in them, and be fix'd into one Tube in the Middle of the Room from which a Conduit of brick or ſtone ſhould be made into the Middle of the Battery, (if the Diſtance between the Bellows and the Battery is ſomething long it matters not) and proportionable Tube, or Conduits, to be branched to, and blow under the Breach of each Gun. I imagine two Bellows to each Gun in a cloſe Caſe-matted Battery will be ſufficient, but Experience is the beſt Inſtructor.

The Deſcription of a Battery, according to Plans in Plate 6, *Fig.* 1, 2, 3.

In a dry Situation (I imagine the Capital of the Baſtion a proper Place for thoſe Batteries;) lay the Foundation as low as the Bottom of the Ditch, and to prevent, as much as poſſible, ſuch Batteries being blown up by an Enemy, drive or place Piles quite round the Battery, a proper Diſtance from the Foundation, about ſix or nine Inches apart from each other; each Pile to be bored like a Pump, that the Miners Approach may be heard, and plainly diſcovered, and their Progreſs ſtop'd at the Piles, by putting Gunpowder down thoſe Piles which the Miners have either cut or dug under, and Fire after it; or thoſe pierced Piles may be cloſe together and long iron Bars drop'd down to ſtop the Miners; for their Arrival at the Piles will be eaſily diſcovered, by liſtening at the Top of them. It appears to me, Miners will find it extremely difficulty to paſs ſuch

Piles if they are very deep in the Ground as their Galleries may, at all times, may be pierc'd from the Top through the Piles, and Gun-powder or ſuffocating Matter continually put down, and the Vent through the Piles ſtoped above; nor can the Cannon or Bombs of an Enemy prevent this, for the Heads of the Piles may be any Depth under Ground, and arch'd over, not leaving ſufficient Height for Miners to make Galleries over the Arch undiſcovered, ſuch Piles may in ſome other Reſpects be of Service in the Defence of the Place, as will be ſhown hereafter.

As this Battery will be a very great Weight, the Foundation muſt be broad, and very good, and built with Stone or Brick within about two Feet of the Height of the Rampire, or Terra-plain of the Baſtion, to have a ſtrong Pier for each Coin, and a ſmaller Pier in the Middle on each Side, and each Side to have two Openings arched, but not ſo high as the Surface of the Ground by ſix or ſeven Feet; and a ſufficient ſquare Opening in the Middle from the Foundation to the Top, but arched over, and made Bomb-proof at the Height of the low Platform, under which Arch the Bellows are to work to blow the Smoke away; this ſquare Opening in the Middle to be thirty, or forty Feet ſquare in *Fig.* 1, 2, 3, and open from the low Plat-forms upward, for the Smoke to go out.

When the Battery is raiſed within about two Feet of the Surface of the Ground, begin to build the outſide of thoſe Fronts, that Beſiegers can place Guns to bear upon, with Blocks of Pebble Stones run together with Metal of old Guns, or any other cheap Sort of caſt Iron; theſe Blocks made of Iron and Pebbles, to be of a ſufficient Thickneſs in the Wall, and well back'd with Maſonry, and built to the Height of the Plat-forms on which the firſt Tier of Cannon are to be planted.

At

At the Height of theſe lower Plat-forms, begin to build the Outſide of thoſe Fronts of the Battery, which an Enemy can bring Cannon to bear direct upon, with ſolid caſt Iron, ſufficiently ſtrong to reſiſt and break the heavieſt Cannon Balls; the Iron is to be well back'd with Maſonry between the Guns, which Maſonry is to bear the Arches, but no Maſonry is to be where the Muzzles of the Guns lie through; the Thickneſs of the Iron is all the Guns Muzzles are to lie through, by this Means there need not be ſo much open Space between the Muzzrling of the Gun, and the Embraſſure, (or rather round Port-hole that holds the Gun's Muzzle) as to admit a Six-pound Ball: How the Guns are to be worked in this ſort of Battery will be ſhewn hereafter.

Having finiſhed the low Battery, *Fig.* 2. and carried up the Piers that ſupport the upper Battery, *Fig.* 3. whoſe Fronts are ſquare on the Diagonal of the low Battery, ſee the Plans *Fig.* 2 and 3. *Plate* VI. this upper Battery to be the ſame in all Reſpects as the low Battery, only its Fronts are not ſo long as the Fronts of the low Battery.

The Fronts of the upper Battery being ſquare with the Diagonals of the low Battery, give ſo great Advantage, that twelve Guns at leaſt, will not only bear upon an Object, in any Part without the Works, but alſo will command a Breach in any Part of the Works, though there are only a Battery in every ſecond Baſtion. See the Batteries E and F *Plate* VI. in the Baſtions G and H.

Of Guns, Gun-Carriages, and Plat-forms proper for the Improvements here propoſed.

The Guns to be made with two additional Trunnions at the Extremity of the Breach, and a ſtrong Pivot on the under Side of the Muzzle, projected

one Inch and an half below the Superfices of the Metal, to fit into a Place on the under or low Side of the Embraſſure or Port-hole made for that Purpoſe, to hold the Muzzle of the Gun in the Middle of the Port-hole, when the Gun is moved Side-ways; but the Muzzle of the Gun to be raiſed from this Hold when fired. This is all the Alteration I propoſe in the Guns, except it hereafter be found practicable, to make Guns to be loaded at the Breech, by a Contrivance proper for that Purpoſe.

The Gun-carriages to have fixed in them, ſtrong purchaſing Hand-ſcrews, one under each Trunnion, and one under the Breech or Pammel, five in Number, to lay the Gun to ſhoot high or low at Pleaſure, without raiſing or lowering the Muzzle; by this Means, and by what follows concerning Plat-forms, the Out-ſide of Embraſſures or Port-holes need be little bigger than to receive the Muzzle of the Gun, ſuppoſing the Embraſſure or Port-hole to be made of Caſt-iron or other ſtrong Metal.

The Plat-forms to have a ſtrong Plank circular Edgeways, to lie under the fore Wheels of the Gun-carriage, when the Gun is run out; this Plank to lie flat upon proper Rolls, and make a Part of the Plat-form, ſo that theſe Rolls will eaſily run the Plank to either Side of the Plat-form, and carry the Gun with it, and traverſe the Gun with little Trouble; there may be another ſuch Plank under the hind Wheels, but I think a Wheel may be contrived to be under the Middle of the hind Axle-tree to anſwer better.

By what is ſaid above, it is eaſy to underſtand by the Methods here propoſed, that the whole Body of the Gun is to be moved to give Direction to the Shots, this perhaps will appear prepoſterous, but I make no doubt if a Trial is made, according to the Method here propoſed, the Difference of Time and

Labour

Labour in fighting Cannon by this or the Method now uſed will be found inconſiderable, for in Service where the Object is generally fix'd, the Direction of Guns doth not want much altering, but the Advantage of having Embraſſures, that in a great Meaſure ſecures the Guns from being diſmounted, and alſo covers the Men ſo effectually, that but few can be killed, being ſo very intereſting will I hope induce ſome able Perſons to promote the Deſign.

I have propoſed to build with large Pebble-ſtones, run together with the Metal of old Guns for cheapneſs; but ſmall Pebble-ſtones run together with Lead, I think in ſome Caſes are preferable, as Splinters will rarely fly from this Material; nor will a Ball be reflected from it with ſo great a Force, as from caſt Iron.

The Expence of the Materials here recommended, will be different almoſt in every other Place; but in moſt Places where there is a Navigation from the Sea, the Expence will be ſomething near the following Calculation.

It will take near one hundred and fifty Cube Feet of Lead and ſmall Pebbles run together to make one Embraſſure; every ſuch Cube Foot will require near two hundred Weight of Lead * at fifteen Shillings a hundred Weight, by Suppoſition the Pebbles for one Embraſſure may coſt five Pounds in ſome Places; which together with twenty Pounds for Workmanſhip, and ten Pounds to make a Bomb-proof-arch over the Gun, amounts to two hundred and ſixty Pounds.

It will take near one hundred Cube Feet of caſt Iron to make one Embraſſure; a Cube Foot of caſt Iron weighs upwards or about four hundred Pounds Averdupoiſe, a courſe ſort of caſt Iron and old Guns, &c. may be had in England, for about eight or

* In many places the Lead only coſt 14 s. an Hundred Weight.

nine Shillings at moſt, the hundred Weight Freight included; one hundred Cube Feet of which will coſt, at eight ſhillings the hundred Weight, one hundred and ſixty Pounds; which with twenty Pounds for Workmanſhip, and ten Pounds to make a Bomb-proof-arch over the Gun, amounts to one hundred and ninety Pounds: If proper Pieces of caſt Iron for Building can be conveniently form'd from the ſmelting Furnace will ſave much Expence.

If Pebbles run together with caſt Iron will anſwer the End propoſed, one hundred and fifty Cube Feet of this Material, will much ſecure the Men and Gun; about one hundred and half of caſt Iron will (ſtrongly) run a Cube Foot of Pebbles together; the Expence of which for the whole Embraſſure is ninety Pounds, which with twenty Pounds for Workmanſhip, and ten Pounds to make a Bomb-proof-arch over the Gun, and five Pounds for the Pebbles, amounts to one hundred and twenty-five Pounds,

In the above Eſtimate, I do not mean that the Pebbles are to be run together no larger than Foot Cubes; on the contrary, I would have the ſmalleſt Piece in the Work ſixty hundred, and upwards to four, ſix, and eight Tuns in one Piece; the Front of theſe Embraſſures to be ſlop'd about forty-five Degrees, that Balls may glance freely off.

Tho' theſe Embraſſures are very expenſive, (it appears to me) they will be of a ſignal Advantage, eſpecially in Places of Conſequence; for it is eaſy to conceive that the Fire of ſtrong Batteries, whoſe Guns it is next to impoſſible to diſmount, or deſtroy the Men that fight them, will greatly retard the Siege, and to beſiege any conſiderable Town will coſt at leaſt two thouſand Pounds every Day the Siege continues, (including the Army's pay) according to the Accounts of thoſe experienced in Sieges, and by lengthening the Siege a few Days, a Place is

ſometimes

ſometimes ſaved; if not, a few Days will coſt the Enemy, as much more to take the Place, as the Batteries that lengthened the Siege coſt building.

The above Expence of a Siege is coarſely taken from Marſhal *Vauban*'s Account, of Stores required for a Month's Siege, as inſerted in Mr. *John Muller*'s Attack and Defence, *Viz.*

Stores required for a Month's Siege.

Powder as the Garriſon is more or leſs ſtrong	8 or 900,000lb.
Shot for Battering Pieces	6,000
Shot of a leſſer Sort	20,000
Battering Cannon	80
Cannon of a leſſer Sort	40
Small Field Pieces for defending the Lines	20
Mortars for throwing Shells	24
Ditto for throwing Stones	24
Shells for Mortars	15 or 16,000
Hand Granadoes	40,000
Lead Bullets	180,000
Matches	10,000 Brace
Flints for Muſkets beſt Sort	100,000
Plat-forms compleat for Guns	100
Plat-forms for Mortars	60
Spare Carriages for Guns	60
Spare Mortar Beds	30
Spare Sponges, Rammers, and Ladles	20 Sets
Tools to work in Trenches	40,000

Several Hand Jacks, Gins, Sling Carts, Traveling Forges, and other Engines proper to raiſe and carry heavy Burdens; as likewiſe ſome to carry Water to extinguiſh Fire; ſeveral Parcels of ſpare Timber for Bridges, Wheel Wrights, Carpenters, &c.

There are beſides ſeveral other Things neceſſary, as Miners Tools, Mantelets, ſtuffed Gabions, Pickets, and Gabions in great Quantities, Tools for Smiths, Carpenters, and Wheel Wrights, a Number

ber of Horſes for the Artillery; Carts and Waggons ſuch as can be procured in the Country are alſo uſed upon Occaſion; I think the Defence of the Covert-Way may be greatly encreaſed by the different Method ſhown in *Plate* VI. but as that Scale is too ſmall to ſhow the Method clearly, ſee *Plate* VII.

By *Plate* VI. it appears that the Baſtions that have the Capital Batteries in them, are more eaſily maſtered than the Baſtion between them, that has no Batteries in it but the Flanks, for the Beſiegers cannot erect any Battery to make a Breach in the Baſtion L, but twelve Guns at leaſt will bear upon it from the Batteries in the Baſtions G and H, which twelve Guns will do more Execution againſt the Enemy's Batteries, than any Number of the Beſiegers Guns can do againſt the Batteries E F, whoſe Guns alſo commands the Baſtion L ſo greatly, that it is almoſt impoſſible to take it and make Lodgments there; but if the Baſtion G is attacked, the Battery F, in the Baſtion H is too far off to do any great Execution, againſt the Batteries the Beſiegers will raiſe to make a Breach in the Baſtion G, and the Battery in the Baſtion oppoſite the Baſtion L, on the other ſide of the Town, is alſo too far off, and the Height of the Works will prevent thoſe diſtant Batteries from ſeeing the Enemy's Batteries, tho' the upper Tier of Guns in the capital Batteries are deſigned to be about fifteen Feet higher than the Parapet; Therefore hollow Piles muſt be driven and counter Guards, and Mines made before the Baſtions that has the Batteries in them, to make thoſe Baſtion as hard to take as Baſtion L; but if the Place is of ſo great Importance, that the Expence of making ſuch a Battery in each Baſtion as is here propoſed can be complied with, and hollow Piles made a proper Uſe of, the Beſiegers Batteries, and Mines, will meet ſo great Obſtructions, that it will be next

to impoſſible to take the Place, without a much greater Expence than the Place is worth, and,

Suppoſing a watery Situation, where the Beſiegers cannot make Galleries under the Ditch, nor diſmount the Guns in the capital Batteries; I think in this Caſe, it will be impoſſible to make a Paſſage over the Ditch; for, in my Opinion, no Man will attempt to make a Paſſage over a Ditch againſt the Fire of at leaſt eighteen large Cannon; and admit a Paſſage is compleated a croſs a Ditch, at the Expence of the Lives of ten or fifteen thouſand Men, and a Breach made in the Rampier by Mines; for I imagine the capital Batteries will not ſuffer the Beſiegers Cannon to make a Breach. There will be twelve, or eighteen large Cannon to fire into the Breach; and and if (notwithſtanding all this Defence) the Beſiegers make their Way through the Breach, they will be ſtop'd upon the Rampier, in the Middle of a Fire from twenty-four or thirty Cannon, (if there is a Battery in each Baſtion, and twelve or fifteen having only Batteries in each other Baſtion; according to Plate 6,) by a Wall of Maſonry built on the inſide, at a proper Diſtance from the Rampier, and a deep narrow Ditch faced with Maſonry, with hollow Piles drove it its Bottom if the Ditch is dry, to hinder the Miners making a Gallery through the Rampier, and under the Wall, to blow it up; this Wall and Ditch will at leaſt give the Place an Opportunity to capitulate at laſt; for the Fire of the capital Batteries will prevent Lodgments being made by an Enemy, either in the Baſtions or on the Rampier.
See the Wall and Ditch mark'd M *Fig.* 4. Plate VI.

The Piles need not be driven in the Bottom of this Ditch till after it is known what Front will be attack'd; and if the Ground is not Sand nor Gravel, the Piles need not be driven much above ſeven or eight Feet below the Bottom of the Ditch, for the

Ground

Ground being ſtrong Earth, Loom, or Clay, may be bored through the Piles, to a ſufficient Depth for diſcovering the Approach of the Miners piercing their Gallerys, &c.

It is preſumed the Rampier of moſt Places have a Slope on the Inſide, near equal to the Height of the Rampier, which Slope I would take away, and make a Wall of Maſonry, to gain more Room for the Ditch, and Wall, M. Plate 6. before mentioned.

There are ſufficient Room againſt, and partly in the Gorge of each Baſtion, which is at every Corner of this Wall and Ditch, mark'd M. Plate 6. (which Wall and Ditch, may be call'd the capitulating Defence,) to make Places for Muſquetry and Cannon, if neceſſary for the Defence of the Wall and Ditch, ſufficient to oblige the Beſiegers to make a Breach in the Wall by Cannon or Mines, either of which will be attended with a good deal of Difficulty, and Danger; the Wall being defended from Cannon by the Height and Thickneſs of the Rampier; and, the Walls own Defence, joined with the Defence of the capital Batteries, will make an Eſcalade dangerous, and imprudent, and if it is a dry Situation where Galleries can be made under the Ditches, the hollow Piles in the Bottom of the Ditches made a proper Uſe of, will much retard making Mines under the Ditches, Rampier, or inſide Wall, if not wholly prevent their effect.

Objection. A Breach may be made in this Wall, with the ſame Battery that make a Breach in the Rampier, and the Rubbiſh will fill up the narrow Ditch between this Wall and the Rampire.

Anſwer. If ſo, the Breach muſt be made in the Courtain contrary to Art, and as this Wall may be lower than the Rampier, it will require much Time to make a Breach, ſo low in the Rampier as to come at the Wall; beſides the capital Batteries will all the

Time

Time do much Execution, againſt the Beſiegers Batteries; as to the Rubbiſh (filling up the Ditch,) it may be taken away as faſt as it comes in, for nothing can diſturb the Beſieged in this Work, but Shells and Stones, both of which are very uncertain in hitting ſuch a narrow Place as this Ditch will be.

This interiour Ditch and Wall, may be of greater Defence than is yet imagin'd, by all that is ſaid; for the ſmall arch'd inner Baſtions mark'd O, at the Corners, may very conveniently be open towards the Place, Bomb-proof, and ſunk low; for the Ditch is deſigned to be very deep at the Gorge of each Baſtion, and the Bottom of the Ditch riſe towards the Middle, and the ſmall inner Baſtions-Tops or Terra-plain are to riſe towards the Middle, ſo that the Cannon planted below, will graze along the Bottom of the Ditch, and the Top of the next ſmaller inner Baſtion half way over it, and the Muſquetry and ſmall Cannon planted in Bomb-proof Places, above theſe Cannon that are planted at the Bottom of the Ditch; will alſo defend the Faces, and Tops of the ſmall inner Baſtions, mark'd O; P Stairs down to an under ground Communication Q, where the Ditch is dry.

RECAPITULATION.

ALL the additional Strength here propoſed to Places fortified according to the preſent Methods of Fortifying, depend chiefly upon making Batteries in a Fortification, whoſe Fires cannot be ſilenced by the numerous Batteries of Beſiegers; and as the weaker Material cannot perpetually reſt the Strokes of the Stronger, a Battery muſt be made of a Material equal in Strength to Cannon Balls, to effectually reſiſt their Force; for this Reaſon, I have choſe caſt Iron to build thoſe Fronts of the Batteries,

againſt

againſt which an Enemy can bring a great Number of Guns to bear direct; and thoſe Fronts which an Enemy can only batter in an oblique Direction, to be built with Pebbles run together with caſt Iron; which will reſiſt oblique battering a Time ſufficient to tire Beſiegers; and by giving the Fronts of thoſe Batteries a great Slope, (about 45 Degrees;) Pebbles run together with caſt Iron may be ſufficient, to reſiſt any Battering, and will be much cheaper than ſolid caſt Iron, only having the Holes in which the Guns Muzzels lie to fire through, of ſtrong ſolid Metal.

The Muzzles of the Cannon in theſe Batteries, are to lie nearly fair with the Face of the metal Wall, ſo the Beſiegers cannot diſmount them nor kill any Man in the Battery, excepting a direct Shot hitting the Face of the Muzzel can diſmount a Gun; which being admitted, yet the Difficulty of hitting ſo ſmall an Object is ſo great, but few Guns will be diſmounted in that Manner; and the Enemy's Guns and Batteries will ſuffer greatly all the Time, and I cannot conceive it poſſible for the Beſiegers to bring ſufficient Metal Batteries to a Siege; therefore a Place defended by a few ſuch Batteries, as are here propoſed, will have great Advantages over the Beſiegers Batteries and Approaches.

Theſe Metal Batteries can only be deſtroyed by Mines, and that only when in a dry Situation; but if proper practicable Means are made Uſe of, to obſtruct the Enemy Miners, it will be next to impoſſible they can be blow'd up; for as theſe Batteries are of a ſmall Extent, they may be well guarded with Mines, and Galleries; which hollow Mines and Galleries, being properly guarded with hollow Piles, in the Manner already deſcribed, will give an Enemy almoſt endleſs Trouble to get under the Batteries.

The

The greateſt Objection I can conceive againſt Metal Batteries in a Fortification, (the Expence expected) is the Miſchief Balls will do by rebounding, which in a large Place may prove conſiderable; but in Places of a middle Extent, Balls generally will fly clear of all; as the Cannon muſt be planted very near if they hope to do any Execution, and conſequently the Balls will ſtrike the Slope of the Battery very ſtrongly, with an upward Direction, ſo as to rebound over the higheſt Buildings in a Place of midling Extent.

If the metal Batteries according to the Plans 1. 2. 3. *Plate* VI, are too expenſive for Places of common Importance, Batteries of Metal leſs expenſive, may be made that will add conſiderably towards rendering the Advantages of Fortification equal to thoſe of the Attack.

I would make theſe Batteries circular, with Gun-ports about nine Feet aſunder, that more Guns may bear to an Object, and every ſecond Gun to be prepared and fired, while the next Gun on each Side (being run in by the Recoyle in firing) are loading, by this Method almoſt a conſtant Fire may be kept up, and near double the Number of Guns will bear upon an Object (and half fire at a time) as can be brought to bear upon an Object, through a thick Parapet, where there are but one Gun in every ſeventeen or eighteen Feet length of Parapet; and that the Guns may recoyle furthe to give Room, the Plat-forms may be laid level, or if need be inſtead of the Platforms Ends toward which the Gun recoyls, being higherthan the other End, they may be lower if Neceſſary.

If a Place is of no great Importance, and of a ſmall Extent, one circular metal top'd Battery raiſed in the Centre of the Town, to fire (on every Side) over the * Tops of the Buildings, will conſiderably annoy

* Where a Battery of this kind is, the Buildings next the Rampiers muſt be low.

annoy the Beſiegers; while at ſome conſiderable Diſtance beyond the Works; the exceſſive Height of this Battery, with Guns the Enemy cannot diſmount, (till they have battered away the ſolid Maſonry below the Metal Top, ſo as to throw it down; but this will both require much Time, and coſt the Enemy † dear, if the Battery is built as it ſhould be,) will be a great Annoyance to the Beſiegers Batteries, and will well defend a Breach on any Side of the Town; the many Rooms under this Battery, being Bomb-proof, will be exceeding uſeful; nor need this Battery have any Baſtions to defend it when the Town is taken, nor cover more Ground than is neceſſary to ſupport the Superſtructure‡, if in a wet Situation, and yet be defenceable to hold out a conſiderable Time after the Town is taken, as the new Method of fortifying contained in the next two Chapters will ſhow; ſee *Fig.* 10. *Plate* VIII.

CHAP. III.

Explanation of *Fig.* 1. *Plate* VII.

A new Method to fortify a Re-entering Angle.

AA The Ditch at the Foot of the Eſcarpe.
BA The ſloping Heigth of the Body of the Place.
CD

† This Battery will much annoy the Beſiegers in their Approaches, and ruin their Batteries till they get near the Body of the Place, and are covered by the Works of the Town.

‡ If the Situation is dry, the Bottom of this Battery, being of a ſmall Extent, may be well ſecured with Mines, and hollow Piles, at a little Expence; and the Bottom being very thick of ſolid Maſonry, with a great Thickneſs of Earth round it, will require a very conſiderable Time to make a ſufficient Breach with Cannon.

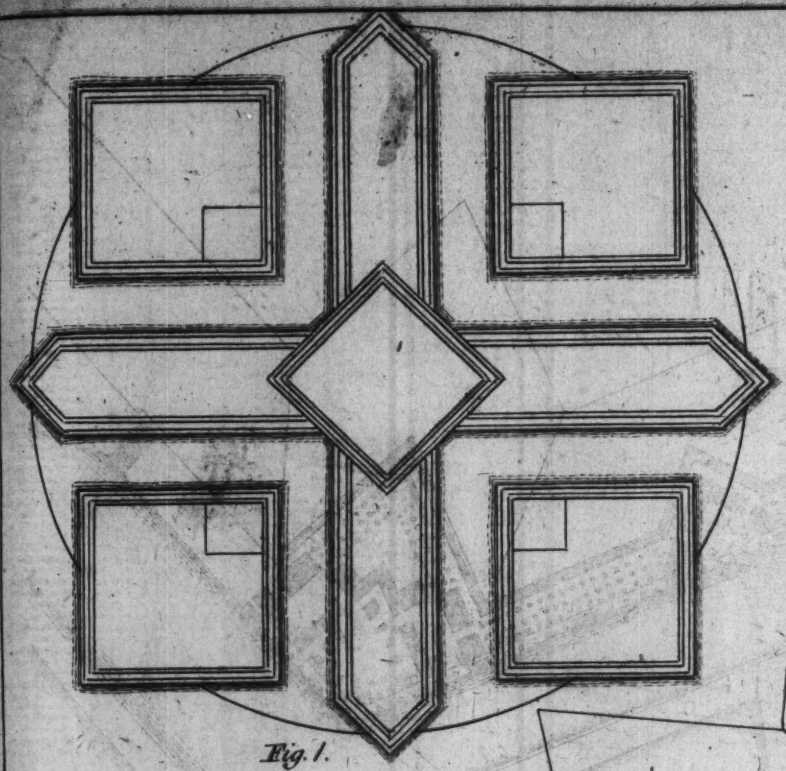


Fig. 1.

P

Q

Q

G

N

E

N

O

H

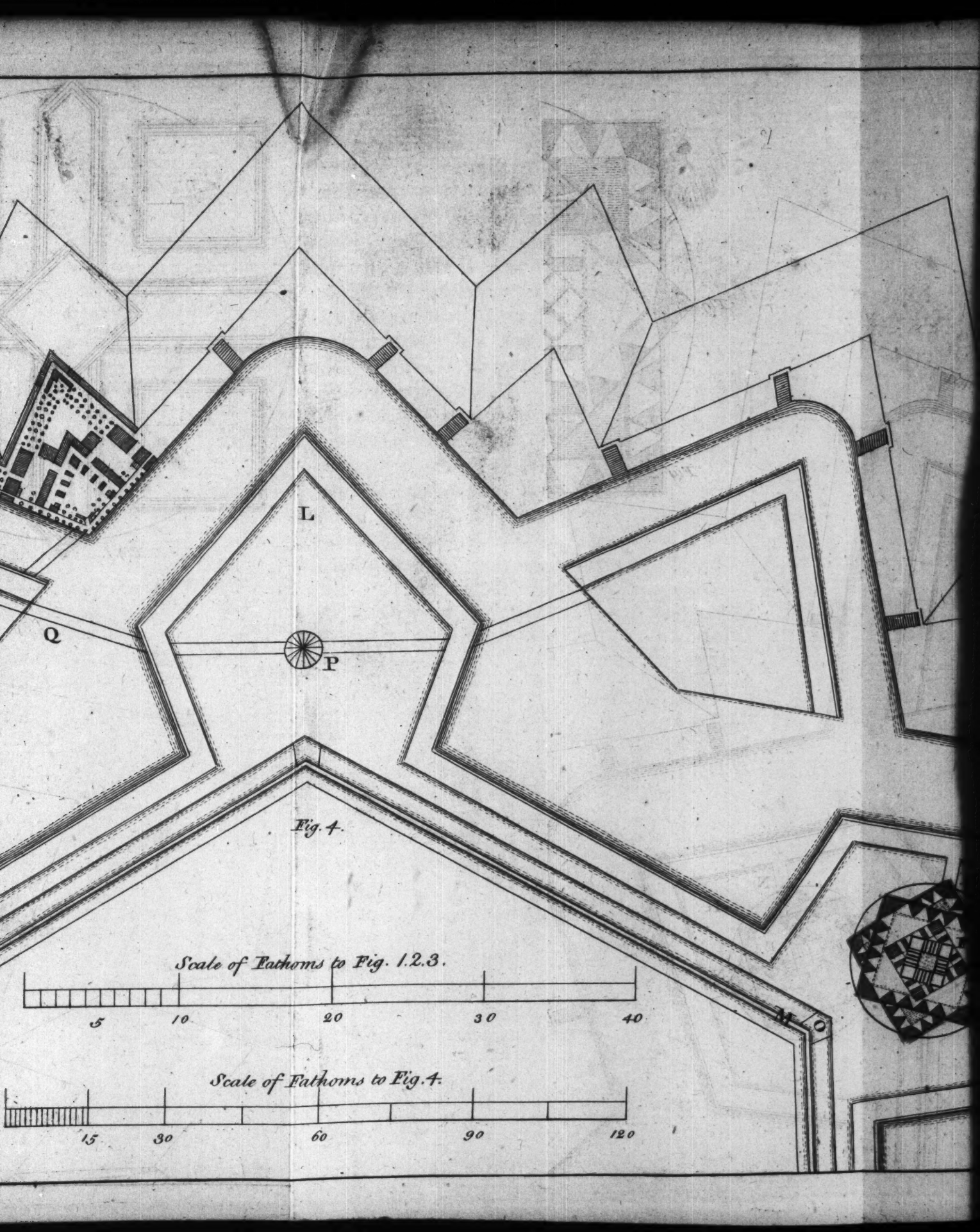

L
Q
P
M
O
Scale of Fathoms to Fig. 1.2.3.
5
10
20
30
40
Scale of Fathoms to Fig. 4.
15
30
60
90
120

Fig. 4.

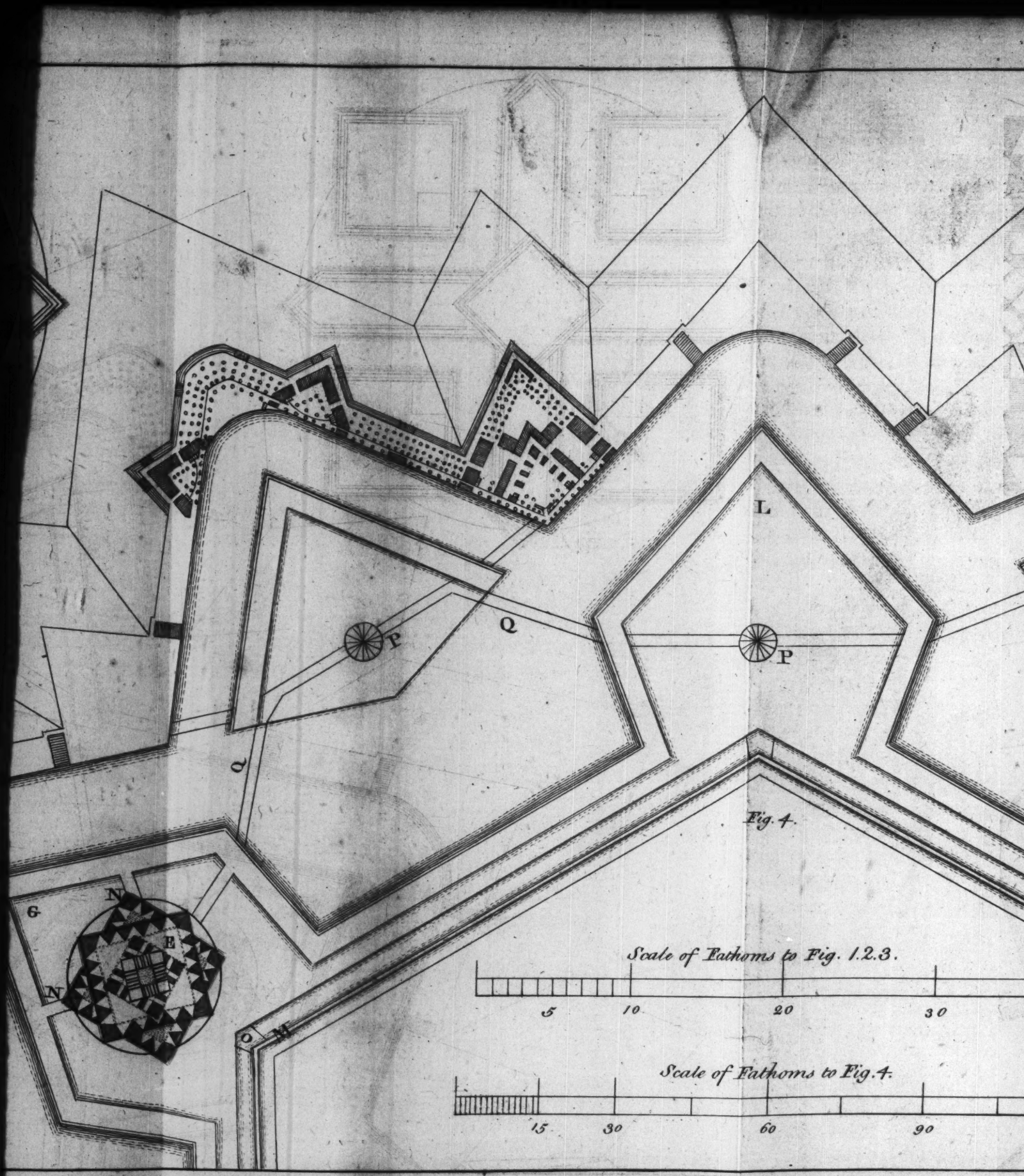


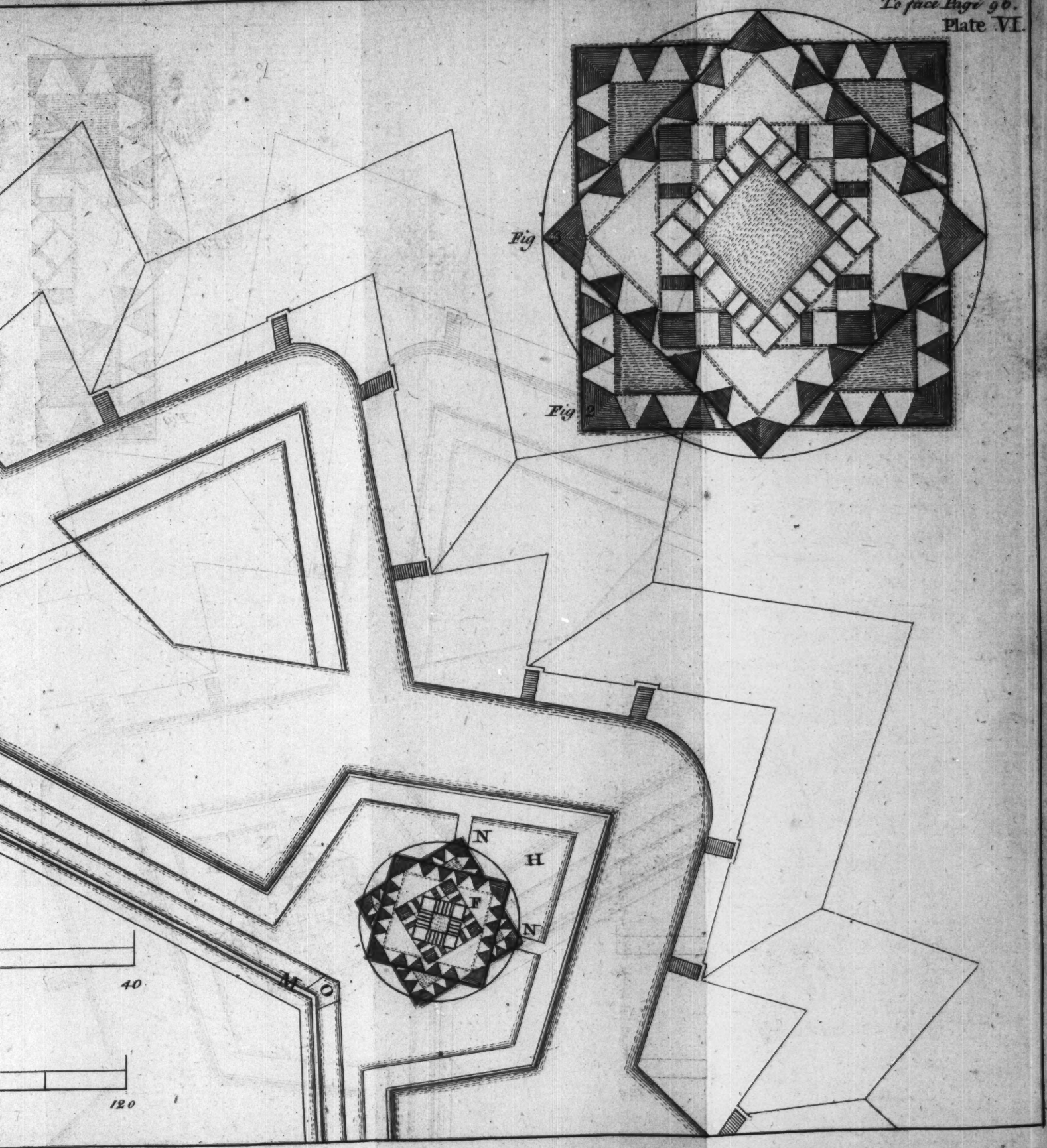
Fig. 4.

Scale of Fathoms to Fig. 1.2.3.

5 10 20 30

Scale of Fathoms to Fig. 4.

15 30 60 90


Fig
Fig 2
N
H
F
N
M
O
40
120

CD The Breadth of the Rampier, excluſive of the Slopes and Parapet.
E The inward Slope.
F. Traverſes
G Places of Cannon and Mortars.
H Lodgments covered Bomb-proof.
II Paſſage round the Body of the Place.
KK Section through FGH.
L A Receſs or Slope from MM equal to the Parapet q, where at L is an Opening up behind the Parapet for to fire Muſquets or Piſtols, or to throw Granadoes down to MM; or any Spot cloſe along the Bottom of the Wall AA; and to a conſiderable Diſtance from the Wall into the Ditch.
NN The Profile of a new Method of Fortification.
O The Ditch.
P A Covert Way round the Foot of the Eſcarpe.
R Paſſages under the Rampart to S a ſecure Place for Muſquetry to defend the Covert Ways, Ditch, &c.
7. 8. 9. 10. 11. Profile of the Covert Ways.
8. The great Covert Way.
9. Paſſage round the Covert Way at the Top of the Steps up which the Muſquetry mount to fire.
10. 11. Earth to ſecure the Men from Shells, Stones &c.
13. A Gallery round the Place below the Covert-way.

Explanation of *Fig.* 2.

A Method to make a Covert Way of greater Defence.

T A Stone or Brick Redoubt, in the Place of Arms.
UU Arches Boom-proof.
WW A clear Paſſage, quite round under the Arches UU.
X A Ditch ending at the Traverſes ZZ.
Y Piers of Brick, or Stone, over which a Platform

of Timber muſt be laid, to ſupport a ſufficient Thickneſs of Earth, in Time of a Siege.

Z Traverſes.

1 Paſſage round the great Covert-way.

2 Steps up, from under the timber Platform made Bomb-proof with Earth, to fire over, and upon the Glacis.

3 The great Covert-way.

4 The little Covert-way.

5 Paſſages through the Traverſes under Arches.

6 Stairs of Communication.

As all, or as many as poſſible of the Cannon, which can play upon the Glacis are generally ſilenced, before the Beſiegers attempt to make Lodgements on the Covert-way, or plant Batteries upon the Ridge of the Glacis; and Batteries on the Right and Left of the Attack, can play upon the Top of the Parapet of the Body of the Place, and Ravelin, and leſſen the Fire of the Muſquetry, all the while the Beſiegers are raiſing Batteries, upon the Ridge of the Glacis; ſo that the Flanks are almoſt the only Defence the Beſiegers have left; (after the Outwarks are taken) whoſe Defence can annoy the Beſiegers but very little upon the Ridge of the Glacis, or on the Covert-way; ſo that Places generally capitulate ſoon after the Beſiegers are Maſters of the Covert-way, and have begun to batter in Breach; for the numerous Batteries of the Beſiegers, having in a great Meaſure ſilenced the Beſieged's Fire, the making Breaches, and croſſing the Ditch, have ſeldom met with many Difficulties of late, but what were eaſily ſurmounted, by the ſuperiour Strength of the Beſiegers; therefore, to render Fortification in this, and other Reſpects, more equal to the Attack, the Profile 7, 8, 9, 13, *Fig.* 1, and the Plan *Fig.* 2, *Plate* 7, ſhews that a Covert-way may be made of ſo great a Defence, without augmenting the

Garriſon

Garriſon as to coſt the Beſiegers more than double the hitherto common Expence of taking Covert-ways.

REMARKS on *Fig.* 1 and 2, *Plate* VII.

It appears to me the Troops cannot be drove out of this new Covert-Way, *Fig.* 2, *Plate* VII, by Sword in Hand only, let the Beſiegers be ever ſo ſtrong, without loſing five Hundred Men, or more, for every Hundred that defends the Covert-Way; as I think will appear to any one who underſtands Attack and Defence, by inſpecting *Plate* VII.

Nor can they be drove out of this Covert-Way by Shells and Stones, till all, or the greateſt Part of the Platform covered with ſix or ſeven Feet Thickneſs of Earth, 10, 11, *Fig.* 1, are beat down by Bombs; which will coſt the Beſiegers much Time, as many of their Bombs will miſs the Parapet; it being too nice a Point to throw every Bomb to a certain Length, or always within twenty or forty Feet of a certain Length.

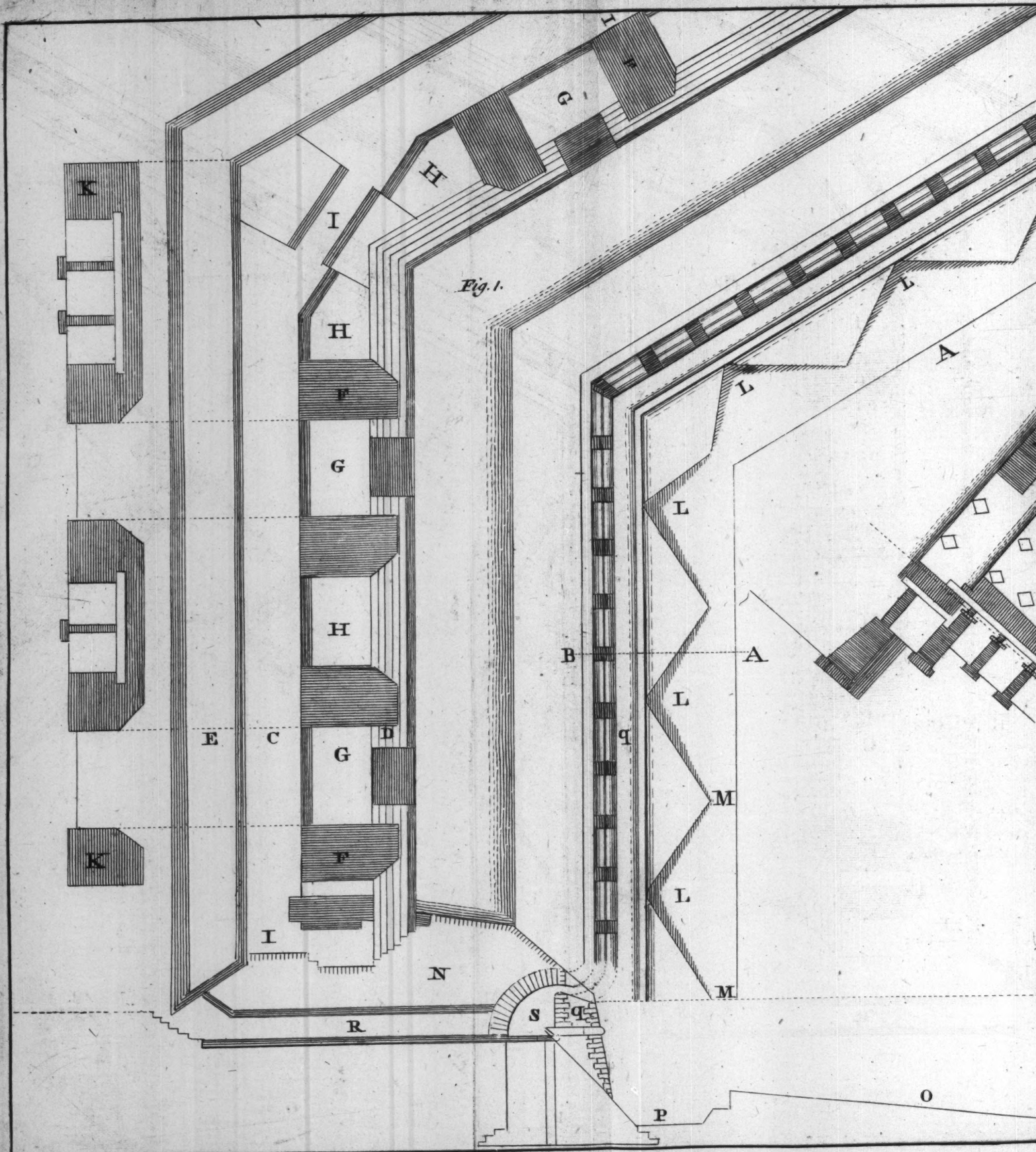
If the Beſiegers attempt to take this Covert-Way by Mines, the Gallery 13, and a proper Uſe made of hollow Piles and ſtinking Matter (mentioned before) will enable the Beſieged to greatly obſtruct the Beſieger's Mines; and many Mines muſt be ſprung before this Covert-Way, the whole Length of the Front attacked, is rendered Defenceleſs; for a Breach alone in the Parapet N, will be of ſmall Advantage to the Beſiegers.

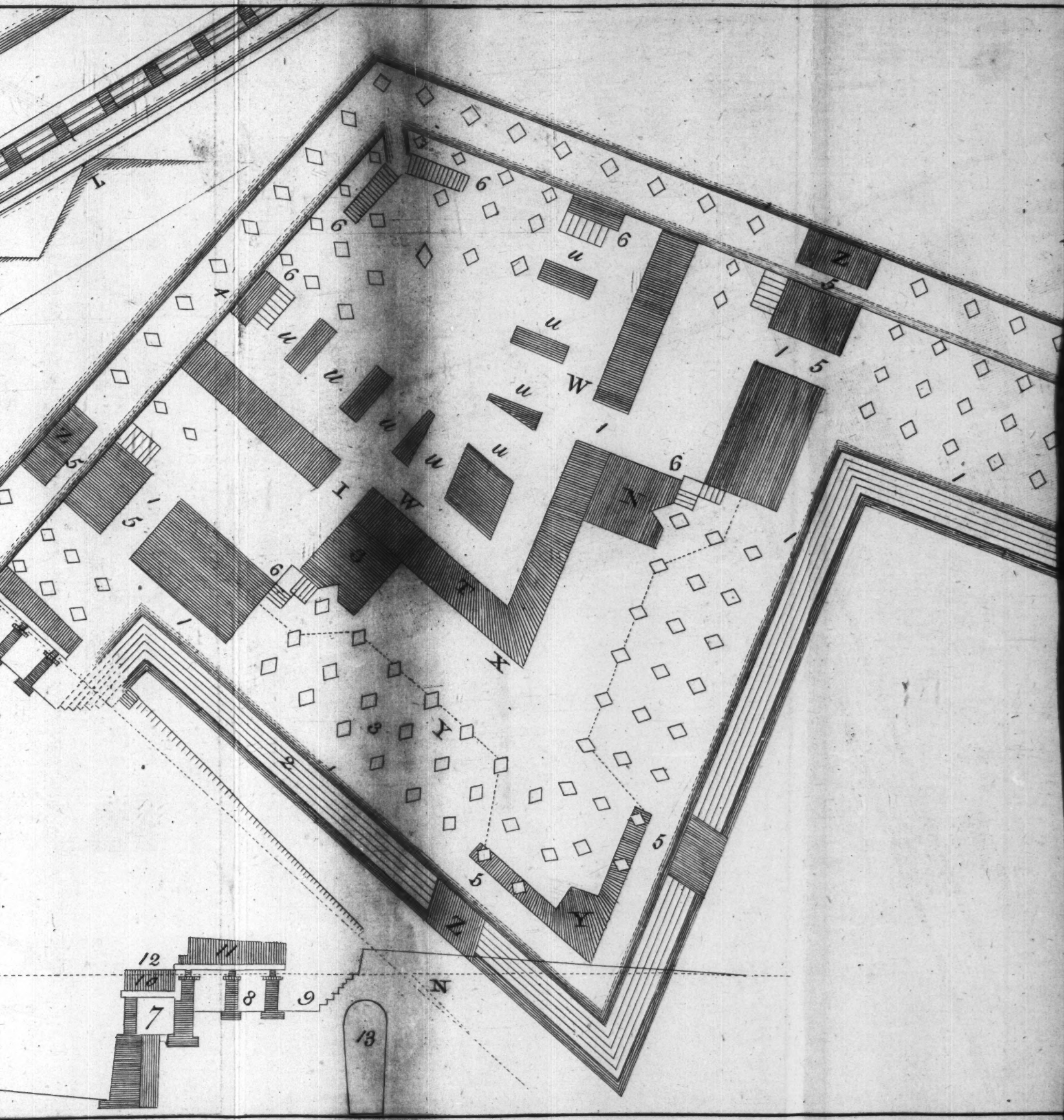
Neither can the Beſiegers raiſe Batteries upon the Ridge of the Glacis, without much Loſs, till the Covert-Way is in their Poſſeſſion; for notwithſtanding the Beſiegers may from a Sap, on the Ridge of the Glacis N, ply the great Covert-Way 8, 9, with Granadoes ſo as to drive the Troops out of it, for a time; the Troops in the little Covert-Way 7, will prevent the Beſiegers from making Lodgements in the great Covert-Way, till both the Covert-Ways are taken, as will appear hereafter; and Troops

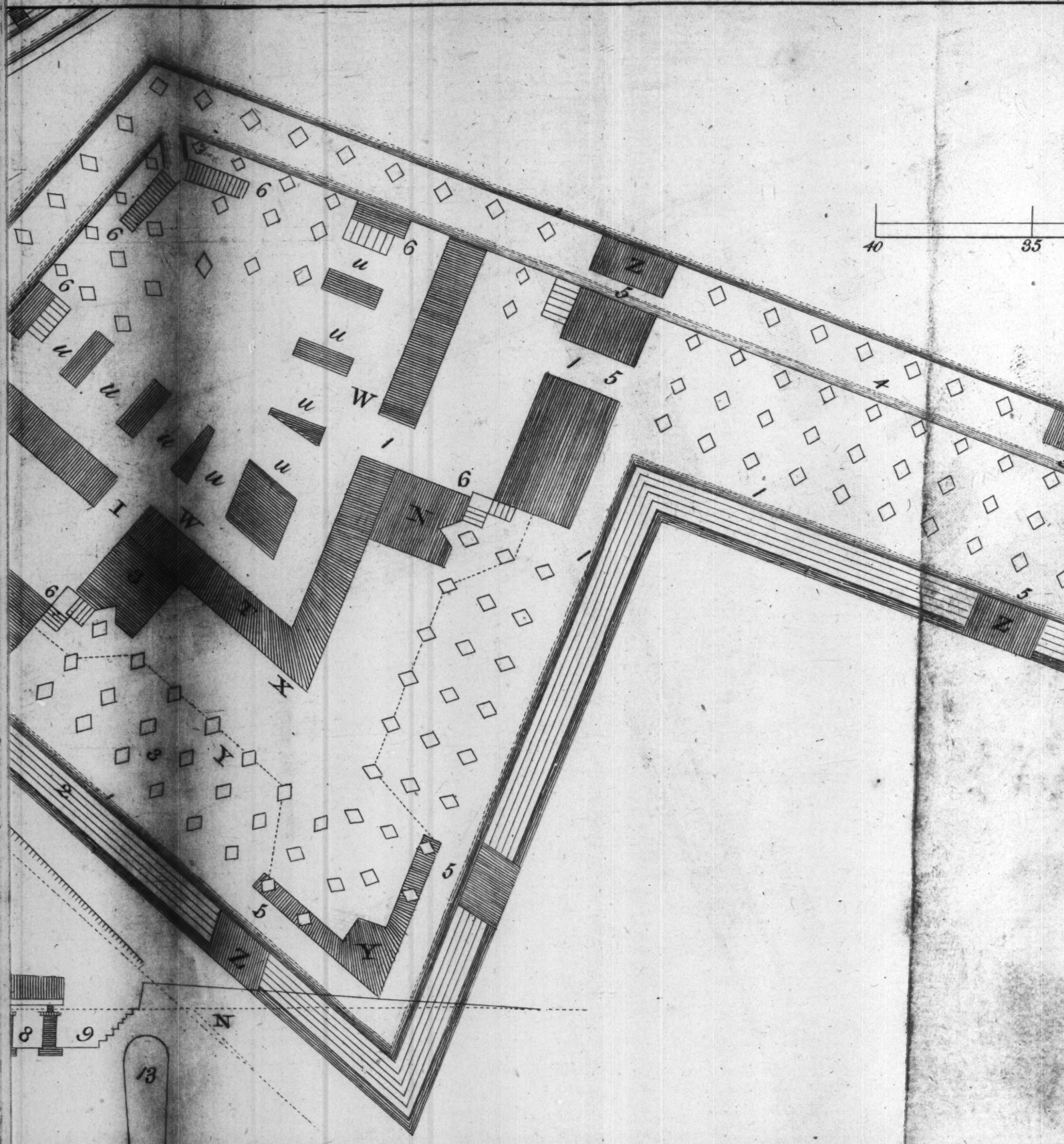
placed at 12, will do much Execution in Caſe of an Enemy's March upon the Glacis, to attack the Covert-Way before the Parapet 11 is deſtroyed; and the Muſquetry at S and P will alſo do much Execution on the Covert-Ways, and prevent the Beſiegers making Lodgements there, even ſuppoſing the Troops are drove out of both the Covert-Ways, to do which will coſt the Beſiegers dear; for till the Parapet 11 on the Covert-Way is deſtroyed, the Defence at *S cannot well be ruined, it being Bomb Proof above, and covered from Cannon by the Parapet 11; the Covert-Way P at the Bottom of the Eſcarpe will likewiſe help to defend theſe Covert-Ways; ſo there muſt be four Defences deſtroyed before the Enemy can maintain their Ground on the Covert-Way; and as two of thoſe Defences cannot be ſilenced, till the Parapet 11 is thrown down, and Batteries raiſed upon the Ridge of the Glacis, thoſe two Defences will be a conſiderable Obſtruction to the Beſiegers, all the Time they are raiſing Batteries on the Ridge of the Glacis to ſilence them; and by inſpecting *Fig.* 1. it is evident the Covert-way can not be taken till the Defences P and S are ruined, which cannot well be done (as I ſaid before) till the greateſt Part of the Parapet 11 is thrown down; and Parapet 11 may be made ſo large a Body of Earth, as to coſt the Beſiegers much Time to deſtroy it, even in a dry Situation where Mines can be made; but if there is Water to fill the Ditch, ſo that Mines cannot be made, ſuch a Parapet will very much retard the Siege.

The *Plates* VI and VII being well underſtood, it (in my Opinion) will appear that Ricochets and Stones will have but little Effect upon the additional new

* The Defence at S is nearly anſwering the Defence of a Fauſe Bray, but is not liable to be enfiladed; nor are the Troops placed there, liable to be drove out by Shells and Stones, as in a Fauſe Bray.


Fig. 1.
K
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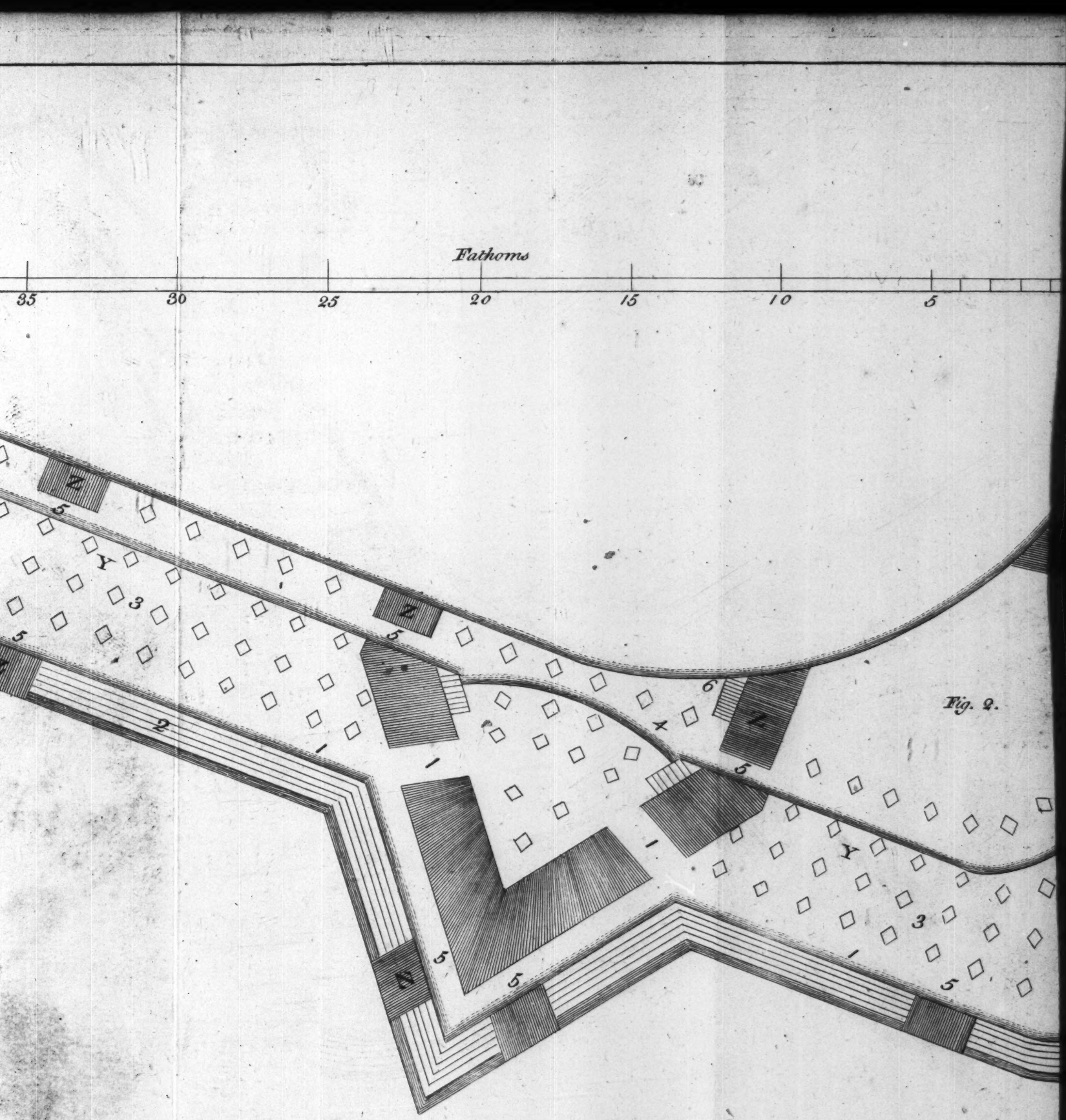
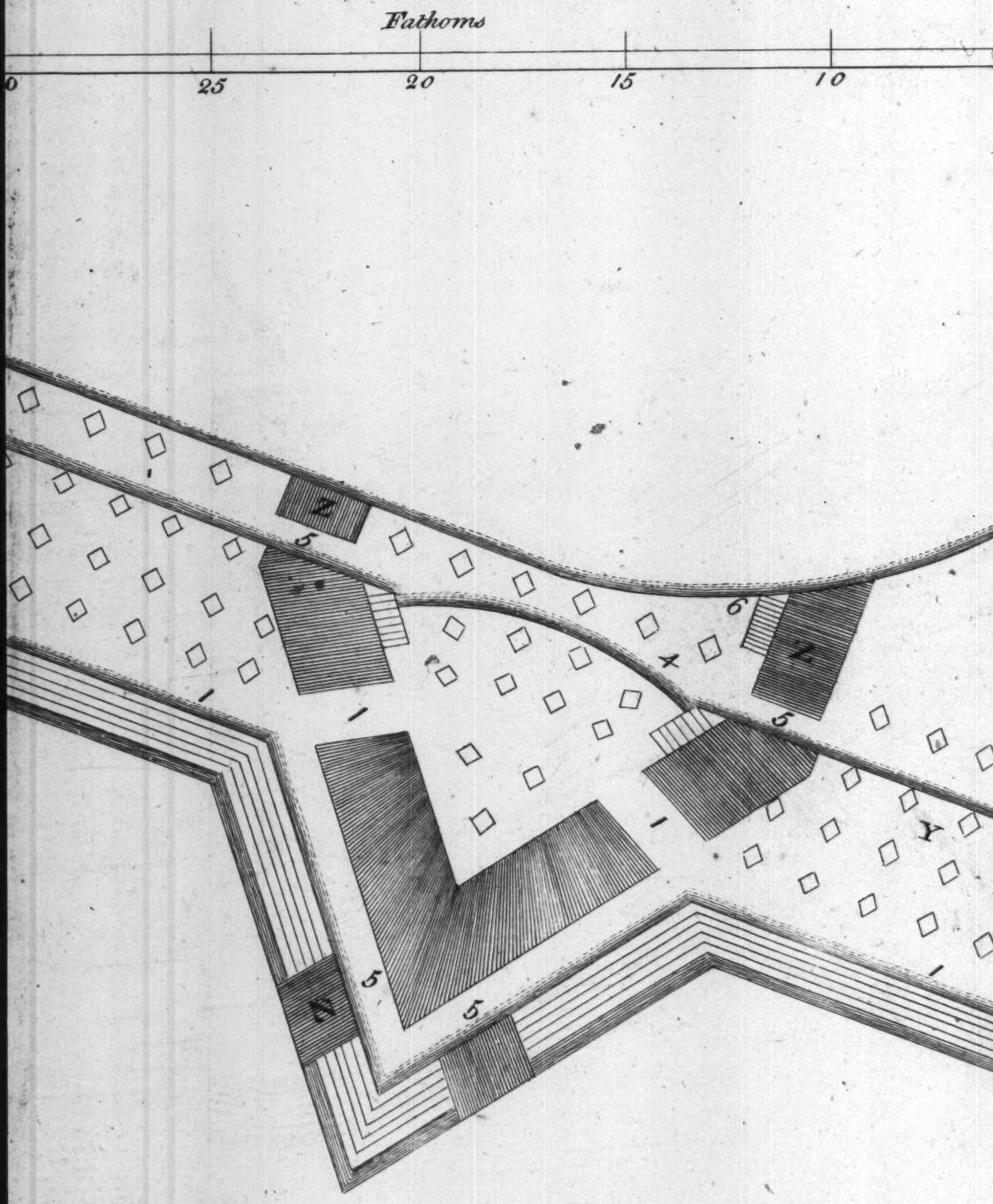


Fig. 2.


Fathoms
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15
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2
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4
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6
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N

Pl. VII

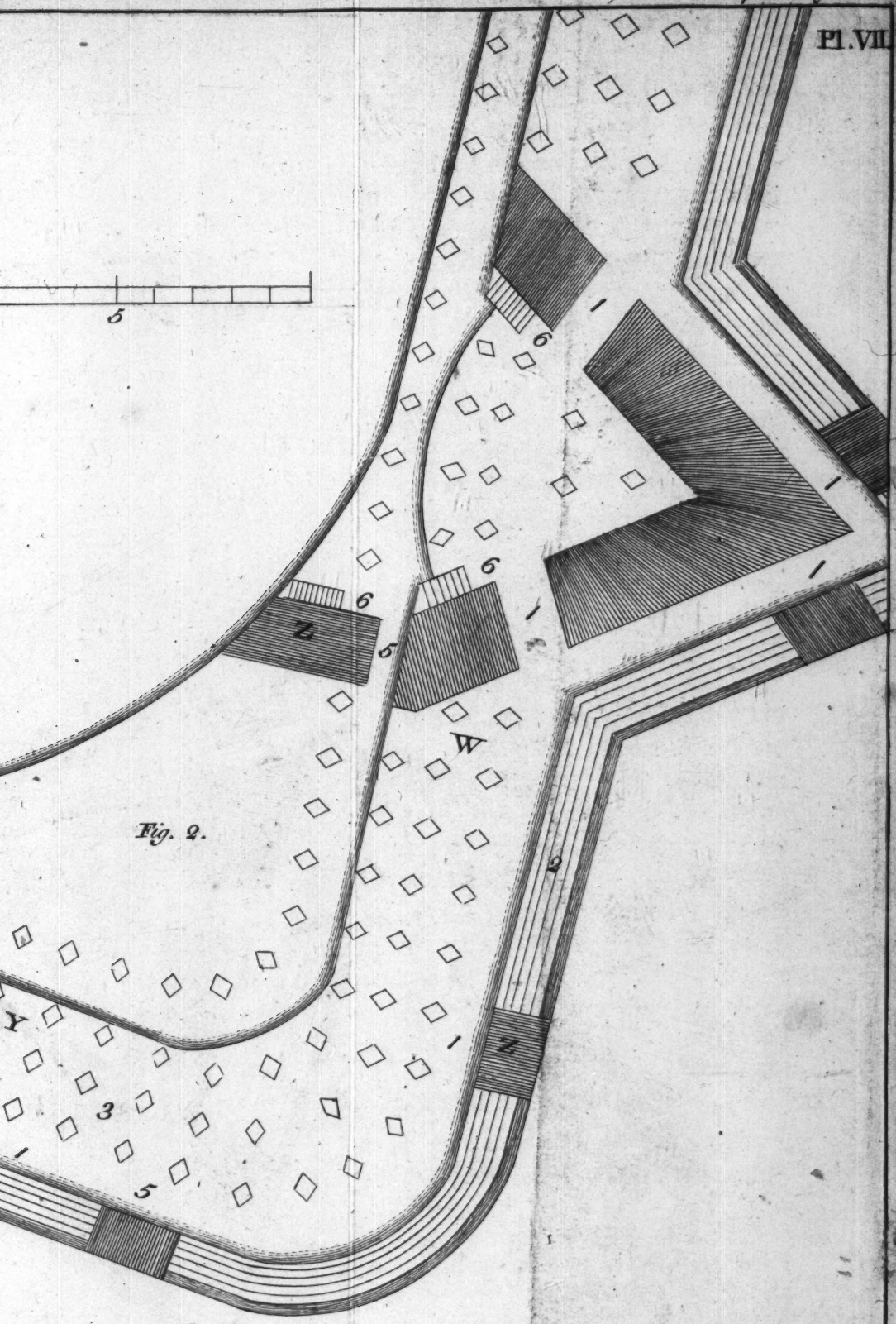


Fig. 2.

new Works; Shells and Cannons will in Time deſtroy theſe Defences, and the ſtrongeſt Works cannot reſiſt Mines properly made, yet notwithſtanding which, it appears to me the Methods here propoſed to ſtrengthen Places already fortified, are not wholly chimerical.

CHAP. IV.

EXPLANATION of PLATE 8.

IN this Plate is ſhown how a Circle may be fortified, which I think is an entire new Invention, *Fig.* 1. The Plan, and *Fig.* 2. The Profile, which being connected by dotted Lines, their Relation are eaſily underſtood, and *Fig.* 2. (The Profile) being explained, *Fig.* 1. (the Plan) need little explaining.

Fig. 2. A. The Glacis.

B. The great Ditch.

C Muſquetoon, Piſtol, and Granadoe Defence; for the Foot of the Scarp, and Bottom of the Ditch.

D Paſſage under the Rampier to C.

E The Entrance into the round Lodgings, G. *Fig.* 1.

F Store Rooms, and Bomb-proof Lodgings, for Men, alſo a Paſſage round the Place under cover Bomb-proof.

G. *Fig.* 2. Bomb-proof Places quite round under F.

H The Ditch round the Keep or Caſtle.

I A wide Place to give Light to the Windows of the Keep or Caſtle, (there are to be no Windows on the Outſide in the Time of a Siege,) and to give Light alſo to the Stair-caſe.

M The Stair-caſe.

N The Mettle-top, a ſtrong Battery of Cannon, Bomb-proof, and open behind.

O Where ſtrong Beams are to be laid, and cover'd with a ſufficient Thickneſs of Earth, when the Place is beſieged.

Fig. 3. The Elevation from the Cordon downward of the Muſquettoon, Piſtol, and Granadoe Defence, to a Quarter of the Keep, A A *Fig.* 1.

Fig. 4. The Elevation of the Line B B *Fig.* 1. where are Store-rooms, and Lodgings for Men, and a Paſſage round the Place Bomb-proof.

Fig. 5. Elevation of the Line CC ſhewing the Entrances of the Paſſages that leads to the Muſquettoon, Piſtol, and Granadoe Defence C, for the Foot of the Scarp, and Bottom of the Ditch.

Fig. 6. Elevation of the Scarp.

Fig. 7. A Plan, or rather Section of the Muſquettoon, Piſtol, and Granadoe Defence at the dotted Line in *Fig.* 6. ſhewing the Length, and Depth of the Receſſes at that Place.

Fig. 8. Plan of the Muſquettoon, &c. Defence, at the Cordon EE in *Fig.* 6.

The Seat of the Parapet covers the ſmall Openings FF ſo far as the black Line GG, ſo that a ſmall Part of the Openings FF are within the Parapet; where Muſquettoons, Piſtols, &c. are fired down, and Hand Granadoes thrown down upon the Enemy at the Foot of the Scarp and Bottom of the Ditch.

Figures, 9, 10, 11, 12, are Copies of *Figures* 2, 3, 6, Plate 8, by a larger Scale; which ſhews the Parts more diſtinctly; therefore the *Figures* 9, 10, 11, 12, being explained, the *Figures* 2, 3, 6, are alſo explained.

Plate 8. As *Figure* 9, and *Fig.* 10, are a Copy of Profile, I explain *Fig.* 2, by explaining *Fig.* 9, and 10.

EXPLA-

EXPLANATION of *Fig.* 9, and 10.

PP The Glacis.

QQ The Ditch and Covert-way.

R The Receſſes for the Muſquetoon, Piſtol, and Granadoe Defence.

S Place for the Troops to defend the Foot of the Scarp, and the Ditch, with Muſquettoons, Piſtols, Granadoes, &c.

T Paſſage under the Rampier into S.

U Door into the Store-rooms mark'd G *Fig.* 1.

W Store-rooms, and a Bomb-proof Paſſage round the Place.

X Lodging-rooms and Store-rooms, quite round the Ditch, Bomb-proof.

Y The Ditch.

Z The Receſs through which the Foot of the Caſtle and the Ditch are defended by Muſquettoons, Piſtols and Granadoes, &c.

1 The Place to hold the Troops that are to defend the Ditch, and Foot of the Caſtle.

2 A ſtrong Battery of Cannon, defended by a metal Parapet; and the Outſide of the Caſtle-top to be metal, five or ſix Feet below the Plat-forms.

3 Strong Beams to be laid upon the Roof, and cover'd with Earth Bomb-proof, in Time of a Siege.

4 An open Place to give Light into the Caſtle and Stair-caſe (there being no Windows in the Outſide of the Caſtle in time of Danger.)

5 A circular Stair-caſe.

6 A Place for Mortars, Cannon, and Muſquetry.

7 A Paſſage under Ground, into the Ditch and Covert-way, Q.

8 9 Galleries round the Place, with hollow Piles to ſtop the Enemies Mines.

EXPLANATION of *Fig.* 11 and 12.

AB A ſhort Length of the Elevation of *Fig.* 10 at Z.

CC The Foot of the Caſtle-wall, and alſo the Wall of *Fig.* 9 at Q, defended down through DDD, from behind the Parapet EE.

FF The Top of the Parapet, wherein is an Arch behind quite round the Place to lodge Muſqueteers.

GG Spaces through which the Muſqueteers are to fire.

HH Strong Pieces of Metal well fixed, to ſupport the Superſtructure, and the Arch behind the Parapet EE.

Fig. 12. Is a ſhort Length of the Elevation of *Fig.* 9 at R, and is in all Reſpects in its Defence the ſame as *Fig.* 11, ſo the Explanation of *Fig.* 11 is alſo an Explanation of *Fig.* 12.

The Method of building a Fort according to Plate 8, is ſo plain and eaſy by Inſpection, that to give a Conſtruction of it here, would be giving the Reader unneceſſary Trouble.

REMARKS on *Plate* 8. *Fig.* 1. *Fig.* 9, and *Fig.* 10.

The Plan this Fort is built upon, being a Circle the Ricochet Batteries are of little or no Service againſt it.

The metal Battery 2 *Fig.* 10, upon the Caſtle, ſeconded by the Cannon and Motars, that may be planted at G *Fig.* 9, will ende it difficult for an Enemy to do much againſt the Place with Cannon; and as every Part is in a great Degree Bomb-proof, it will take a long Time to reduce the Place by Bombs only.

Figure 9. Is a very thick Parapet, it being eleven Fathoms thick, will coſt a long Time to make a ſufficient Breach, and Cannon planted at a Diſtance cannot fire upon this Parapet; the Direction of the Glacis

Glacis PP being near two Fathoms higher, effectually covers it. The metal Battery is the only Object an Enemy can batter, till they advance their Batteries upon the Edge of the Ditch, to do this will coſt them dear, as the metal Battery, and all the Mortars in the Place will inceſſantly play upon them, as alſo will the Cannon planted at G, as ſoon as they appear upon the Edge of the Ditch.

This Fortification being Bomb-proof in every Part, will greatly ſecure the Troops, and as the Beſiegers in their Approaches cannot ſecure themſelves ſo well from Bombs, as they do from Cannon, I would adviſe a good Number of Mortars, Cohorns, &c. in every fortified Place, when in Danger of being beſieged.

If an Enemy attempt to take this Fort by Mineing, the Galleries 8 9, with hollow Piles made a proper Uſe of, will very much obſtruct their Approach, and when the Galleries can no longer be defended, ſuffocating Smoke may be introduced to fill the Galleries, thro' Places prepared before for that Purpoſe, and ſo much ſtinking Smoke may be injected by Bellows, as to render it almoſt impoſſible for the Miners to proceed farther.

Admit the Miners by much Induſtry make a ſufficent number of Openings to the Day, and by that Means, in ſome Degree, clear away the Smoke, and make Mines under *Fig.* 9. It will require ſome conſiderable Time to make ſecure Lodgments in *Fig.* 9, the Caſtle being ſo near, and capable of a good Defence.

If Plenty of Water is to be had (by Springs or otherwiſe) in the Caſtle, the Enemy, in *Fig.* 9 may be very much incommoded, by throwing Water into their Works, and make their Lodgments very uncomfortable, if not intolerable, eſpecially in cold Weather.

As

As it is my Opinion, this Place cannot be taken by Eſcalade, I ſay nothing on that Head.

The metal-top'd Caſtle, *Fig.* 10, *Plate* 8, here ſpoken of, may well ſerve (with ſome ſmall Alteration) for a grand Battery in the Middle of a Town, as ſpoken of in the End of the ſecond Chapter.

EXPLANATION of *Fig.* 1. *Plate* 9.

The Side AB 328 Fathoms and a half, the longeſt Diſtance between the Defences CC, at each End of the Ditch L 133 Fathoms.

D The interior Slope.

E Terre-plain of the Rampier.

F Steps to raiſe the Muſqueteers a ſufficient Height to fire over the Parapet.

G The Top of the Parapet.

H Interior Slope.

I A little Ditch at the Foot of the Scarp.

K The Covert-way in the great Ditch.

L Glacis in the great Ditch.

M A narrow Covert-way,

N Broad Covert-Way.

O Steps up for the Muſquetry to fire upon the Glacis.

P The Glacis.

Q A Second Glacis.

R The lower Tier of Guns in the metal Batteries, the Corners R arch'd Bomb-proof, and the Arches continued under the upper metal Battery S to the Opening T.

S The upper metal Battery raiſed above the metal R, See the Plans, *Fig.* 1, 2, 3. in *Plate* 6.

T A ſquare Opening quite down to the Foundation; the whole Height conſiſts of three Heights of Arches, the firſt Height of Arches being very high, will be two Heights of Rooms for to hold Bellows and People to blow away the Smoke: There may be many more Vents than the Opening T.

The

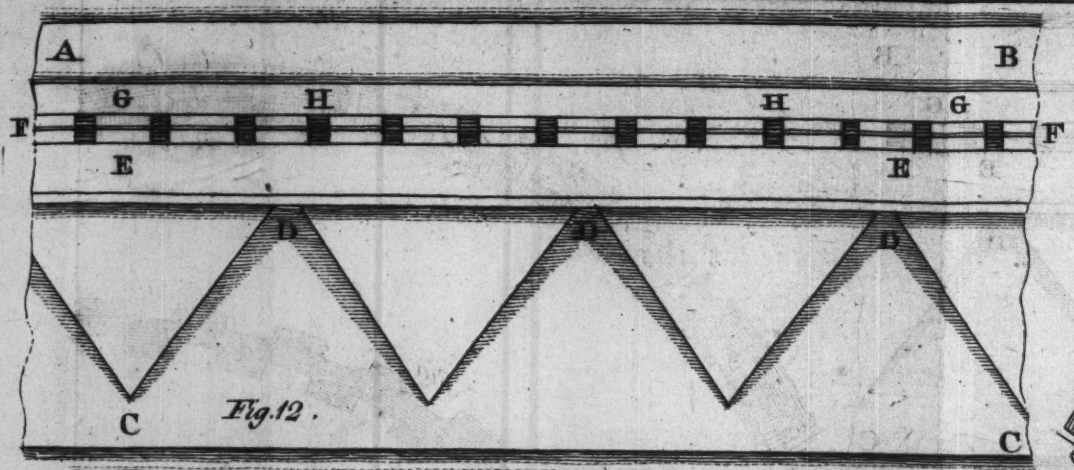


Fig. 12.

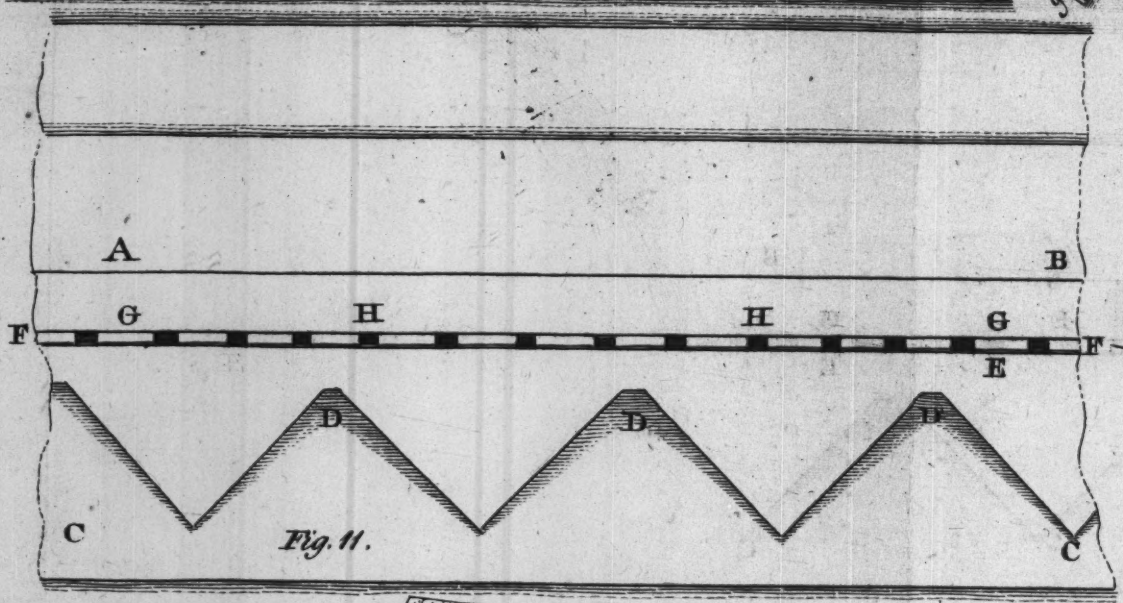


Fig. 11.

Fig. 8.

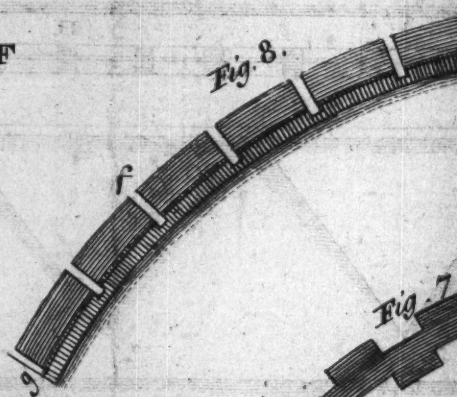


Fig. 7

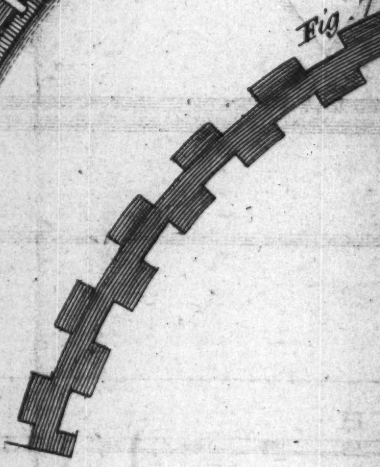


Fig. 10.

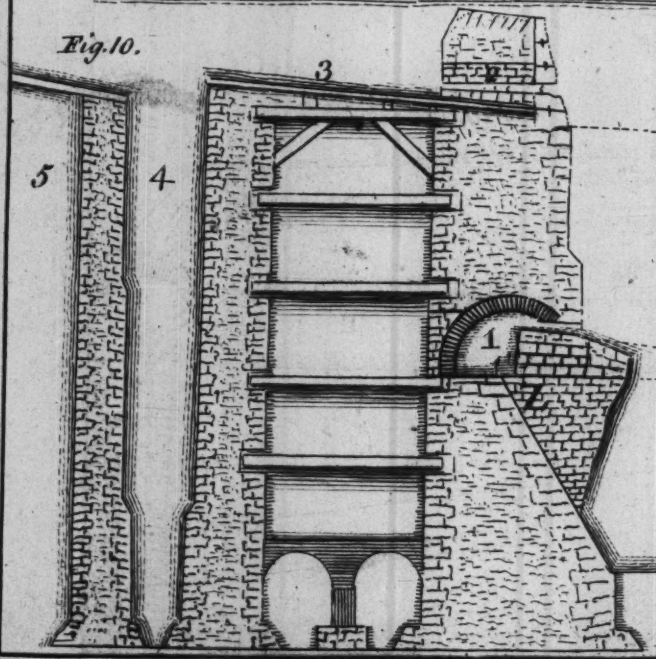
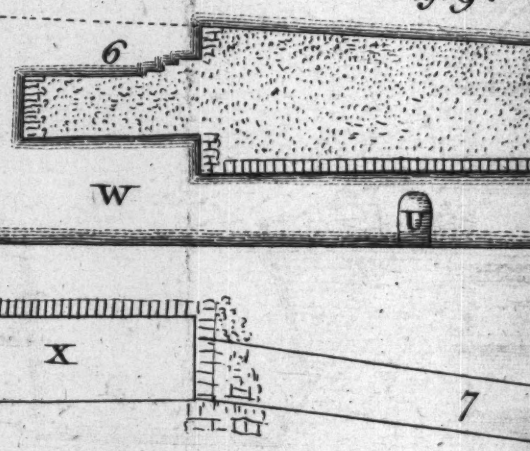
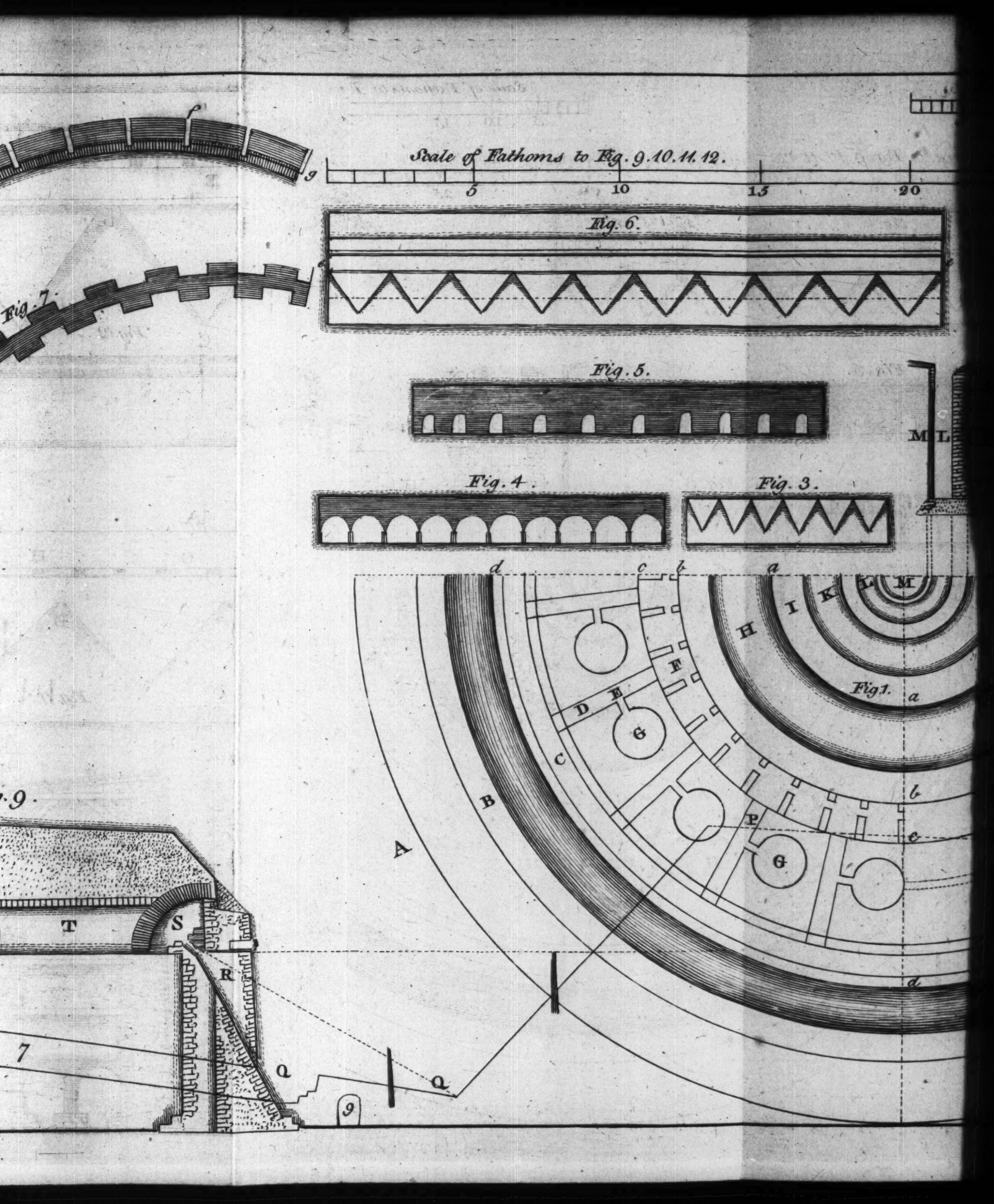


Fig. 9.




Scale of Fathoms to Fig. 9.10.11.12.
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Fig. 6.
Fig. 7.
Fig. 5.
Fig. 4.
Fig. 3.
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c
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a
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I
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Fig. 1.
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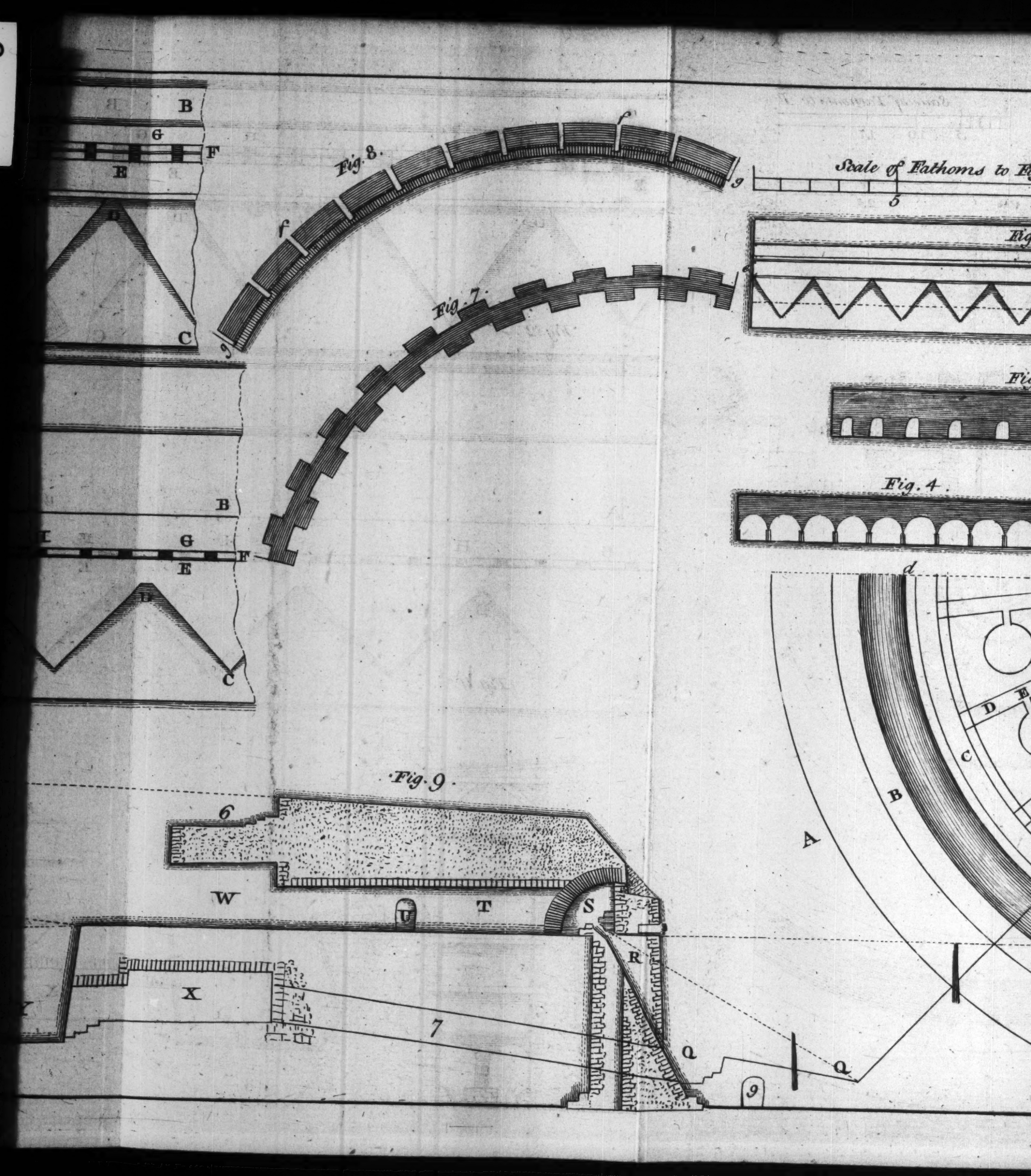

B
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Fig. 8.
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Fig. 7.
Scale of Fathoms to Fi
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Fig
Fig. 4.
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Fig. 9.
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S
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Plate VIII.

Scale of Fathoms to Fig. 1. 2. 3. 4. 5 6. 7. 8.

5 10 15 30 45 60

to Fig. 9. 10. 11. 12.

10 15 20 25 30 35 40

Fig. 6.

Fig. 5.

Fig. 3.

Fig. 2.

Fig. 1.

The white Places are the Embraſſures for the Cannon, and are reverſe to the Embraſſures generally made, the Nature of working Cannon in theſe Batteries are ſhown in the ſecond Chapter, Page 85.

EXPLANATION of *Fig.* 2, Plate 9.

Fig. 5. The Profile of *Fig.* 2, along the Line XY,

Z a Covert-way, the ſame in all Reſpects as N in *Fig.* 1.

a Where Troops are to lie to reſt under Bomb-proof covering, while others are on Duty at z.

b A ſmall Redoubt to defend the Salient Angle.

c A Glacis before the Redoubt.

d Arches Bomb-proof to form a Terre-plain and Parapet for a Glacis.

e Steps down to under-ground Communications with the great Ditch L, and to come out at f.

f Doors in the Counter-ſcarpe to under-ground Paſſages into *Fig.* 2.

g Traverſes to cover the Troops from the Enfilades, while they defend *Fig.* 2.

The EXPLANATION of the Works cut by the Line, U. W. *Fig.* 2.

Fig. 4. Is the Profile along the Lines, U W by a larger Scale, therefore I will explain by the Profile, and the correſponding *Figures* 1, 2, 3, &c. in the Plans of the Works *Figure* 1, will make thoſe Plans underſtood.

U The Coyn of the Scarp of the Body of the Place.

1 A Ditch at the Bottom of the Scarp.

The Space between 1 and 2, a Co rt-way.

2 A Parapet to fire over to defend the Ditch I, and the Foot of the Scarp, *Fig.* 1.

The Lines between 2 and 3 repreſents Steps, up which the Troops aſcend to fire over the Parapet 2.

3 Is arch'd under and to be cover'd Bomb-proof.
4 A deep narrow Ditch, into which the Shells will roll, that falls upon 3 and 5.
5 A ſecond Parapet. The Lines between 5 and 6 repreſents Steps, up which the Troops aſcend from under the Covering 6 to defend the Ditch and Glacis L.
6 Is arch'd under, and the Arches covered Bomb-proof.
7 A deep narrow Ditch, into which the Shells will roll that fall upon 6 and 8.
8 Is arch'd under, and the Arches covered Bomb-proof.
The Space between 8 and 9, repreſents Steps, up which the Troops aſcend to defend the oppoſite Part of the Covert-way.
9 A Parapet behind which Troops defend a Part of the Covert-way MN.
10 A Part of the great Ditch and Glacis L.

It may be proper to mention, that the Works cut by the Line U h W, and mark'd c, defend the great Ditch and Glacis, i k, the ſame is to be underſtood of the Works under the metal Battery B.

I A Place to defend M, and prevent an Enemy being in Safety at M, in caſe Poſſeſſion be got of that Place by underground Works; more need not be ſaid by Way of Explanation, all the Works in this Plate being plain and eaſy to underſtand, (by any one who have but taken a little Trouble to qualify themſelves for ſuch Works) except the metal Batteries, and their Conſtructions may eaſily be underſtood, by any one who is a Judge of Buildings of this Sort, by carefully inſpecting the Plans 1, 2, 3, Plate 6, and attending carefully to what is written in Chap. 2, concerning metal Batteries.

Fig. 3. A Profile a long the Line, p. q. *Fig.* 1.

RE-

Remarks on *Plate* 9.

The detached Works *Fig.* 2. may be omitted, but as the principal Part of this Work is only a Covert-way, if the Parapet of Earth ſupported by Piers to cover the Troops from Shells, Stones, &c. are not made, the Expence of making ſuch Works is inconſiderable, and they will conſiderably obſtruct the Beſiegers in approaching the Place, for,

The Beſiegers cannot make a Parallel ſo near the Covert-way, by ſeventy or eighty Fathoms, till *Fig.* 2 is taken, as they can if theſe Works are omitted, and, theſe Works give the Beſieged an Advantage of ſallying and retreating with the ſame Safety when the Enemy is two hundred and twenty Fathoms from the Covert-way, as they could have without thoſe Works, when the Enemy is within one hundred and forty Fathoms of the Covert-way.

When the Beſiegers are two hundred and twenty Fathoms from the Covert-way, they will be obliged to keep as ſtrong a Guard in the Trenches, and Parallel, as, they need keep at the Diſtance of one hundred and forty Fathoms, if theſe Works are omitted, and conſequently muſt from that Diſtance make their Works larger towards the Place, which will coſt more Labour and Time.

The Communication is ſo ſafe and eaſy between the Body of the Place and Fig. 2, the Troops will well defend that Work; and the Redoubt being a ſafe Retreat under the Fire of the Batteries, A and B, and the ſmall Arms in the Covert-way, &c. The Beſiegers will ſuffer greatly if they attack Fig. 2, above Ground, and make Lodgments in it.

If the Beſiegers paſs by the detach'd Redoubt, Fig. 2, and make their Efforts between it and the metal Batteries A and B, the Beſieged will have great Advantages over the Enemy, they being in Defences ſo near on each ſide the Beſiegers Trenches, where the Beſiegers have not ſufficient Room to make Uſe of their ſuperior Strength.

Fig. 1. The Length of the Front AB being † 328 Fathoms, is a greater Defence, and will coſt more Labour to approach it, than a ſhorter Front; here is nothing in any Part between Fig. 2 and this Front, to afford the Beſiegers any Cover, till they make it; ſo the whole Fire of the Front can fall upon any one Spot of the Glacis P beyond the Covert-way, and the Glacis L in the great Ditch; and the Works c and IC, will contain 140 Muſqueteers at each Angle of the Square, to defend the Ditch; that is, 140 Muſqueteers can fire all together for the Defence of each Front and Ditch; and, theſe Works are ſo well cover'd by the metal Batteries, and Covert-way, that they cannot be Enfiladed from any Part; and are in a great Meaſure ſecured from Bombs, ſee the Profile Fig. 4, Plate 9. The Utility of this new improved Covert-way is ſhown in the Remarks on Fig. 1 and 2, Plate 7, Chap. 3.

Some of the Advantages the metal Batteries will bring on the Side of fortified Places, are ſpoken of in explaining Plate 6, Chap. 2. Therefore I will only in this Place ſpeak of them with Regard to their Situation in Fig. 1, Plate 9.

It appears by Fig 1, that a Square having ſuch a Battery as A or B at each Angle, will be well defended by Cannon, and the Batteries will alſo well defend each other, and there is no Spot within the Reach of thoſe Batteries but twelve Cannon, at leaſt, can bear upon it; and as the upper Tier of Guns in theſe Batteries will be about fifteen or eighteen Feet higher, than the Parapet of the Place, will greatly annoy

† The Front ſhould not much exceed 328 Fathoms, becauſe the Ditch L will be too long between the Works C and I C, to be well defended by the Muſquet: but if a Place is of ſo great Extent as to require a Square whoſe ſide is above 360 Fathoms, and under 700 Fathoms, Works may be made in the Middle of the Front for Muſquetry to defend the Ditch.

annoy the Beſiegers in their Trenches, and as ſix Guns at leaſt and often eight or ten from each Battery, that cannot be diſmounted, will bear upon the Enemy's Works; I do not conceive how the Beſiegers can advance their Works ſo near as to take the Covert-way, againſt ſuch a ſtrong Cannonade as may be kept up by thoſe Batteries.

It is eaſy to perceive that the Covert-way cannot be enfiladed, nor doth it need any Traverſes, altho' it were a common Covert-way, the metal Batteries effectually covers both the Covert-way, and the ſmall Arms that defends the Ditch from Ricochet firing.

I would have the Rampire of the Body of the Place arch'd behind the Parapet, like the Covert-way to ſecure the Troops from the Ricochets Shells, Stones, &c. but if it is not arch'd, the Ricochet Batteries that enfilades it, as there muſt be one on each ſide of the Place to enfilade the whole Length of the Front, it will be expos'd to the Fire of all the metal Batteries, which I think will be more than ſufficient to ſilence all the Batteries the Beſiegers can raiſe againſt the Place.

Theſe metal Batteries are of a ſmall Circumference, and may at a ſmall Expence be guarded well with Galleries, and Mines, and hollow Piles, and ſmall Pipes laid when the Place is built, to fill the diſtant Galleries with ſuffocating Smoak, when neceſſary, and maintain them full; but theſe Pipes muſt be artfully laid, that the Enemy cannot eaſily find them to ſtop them up.

The Reader will eaſily obſerve here is a great Dependance upon the metal Batteries; it being taken for granted, the metal Batteries (being high and ſtrong,) will ſo much obſtruct the Enemy's Batteries, as to render their Cannon of little or no Effect againſt this Sort of Fortification, and reduce the Methods of Attack to Bombs, Mines, and the old Cuſtom

Cuſtom of Rolling-Banks, in a dry Situation; and in a wet Situation, to Bombs and Rolling-Banks only, and conſequently render good Fortifications whoſe Ditches are full of Water, and cannot be drained dry, in a great Meaſure impregnable.

Tho' the Expence of metal Batteries will be very conſiderable, yet, when it is conſidered that few other Works need be made (except it be thought neceſſary to have Steccadoes to prevent the Town's being inſulted or ſurprized in the Night, or a Rampier of Earth to defend the Buildings in the Town from Cannon;) it is not improbable but a Place may be fortified as cheap with metal Batteries, as with Maſonry and Earth, eſpecially where ſtrong Fortifications are made.

With reſpect to the Number of Troops to defend a Fortification according to *Plate* IX. As there are only four Sides or Fronts to defend 4800 Men, I think, is a good and ſufficient Garriſon for a Place ſo fortified; and there is about as much Ground contained within this Square, as is within M. *Vauban*'s Hexagon, whoſe Side is 180* Toiſes; and as an Hexagon has ſix Sides to be defended, and every Side of no eaſier Defence than the Side A B, *Fig.* 1, *Plate* IX, it appears the Hexagon ſhould have a Garriſon of above 6000 Men, to defend it as well as *Fig.* 1. *Plate* IX, can be defended by 4800 Men. And whither a Hexagon of the preſent Fortification, with a Garriſon of 6000 Men, can make ſo good a Defence as a Square fortified according to *Plate* IX, with a Garriſon of 4800 Men, I leave to the Judgment of Engineers who are well acquainted with the Methods of attacking and defending Places.

It being at preſent univerſally believed, that nothing can be built with a tolerable Expence to defend a

* A Toiſe contains 6 French Feet; and a French Foot is to the Engliſh Foot as 16 to 15, nearly.

a Place, but Cannon will beat it down; therefore it may be proper to give a more particular Account of my Ideas, relating to the Conſtruction of Batteries, that cannot be beat down by Cannon nor Bombs.

A few Experiments are neceſſary to fix the Thickneſs of caſt Iron, and Pebbles run together with caſt Iron, &c. ſufficient to long reſiſt, and break the heavieſt Balls, but not having an Opportunity to make ſuch Experiments, and altho' no Theory that I know of gives any Light to this Caſe, I will take it as a Thing certain, that leſs than thirty Inches thickneſs of caſt Iron, will long reſiſt and break the heavieſt Balls.

That Cannon-Balls will break, is beyond Diſpute with me, I having ſeen two Pounds and half Balls fly in Pieces, when thrown by a Man upon a ſmooth fix'd large Pebble Stone.

There are ſeveral Ways to uſe Stone and Metal in making Batteries, whoſe Guns will be made the more difficult to diſmount, according to the Importance of the Place, and the Expence thought proper to beſtow upon it.

There are large Stones of the Pebble Kind, in many Places where I have been, that will make very ſtrong Batteries; they are indeed very hard to work, but a Machine may be made that will work them tolerably cheap. This Sort of Stone will not fly in Splinters near ſo much as the Stone commonly uſed in making Batteries; and it is by much the ſtrongeſt Stone I know (and I have dealt with Stones this Thirty Years laſt paſt,) and when in a large Body, not many Degrees weaker than caſt Iron; and will ſtand longer againſt Time and Weather than any Sort of Iron: In the North of *England* this Stone is called *whin Stone*.

In building a Battery with this Sort of Stone, I would recommend a Piece of ſtrong Metal to have

the Hole through it for the Guns Muzzle† to lie in; and that the Wall have a Slope of 35 or 40 Degrees, eſpecially from five or ſix Feet below the Top.

Batteries may be made that has only Metal extending four or five Feet on each Side the Gun, to put the Gun's Muzzle in to fire through, and an Arch over the Gun, Bomb-Proof; the other Part of the Merlons may be of Maſonry or Earth. This Sort of Battery will much better ſecure the Men and Guns, than any Battery yet built, according to the Accounts I have had from Authors, and by what I have ſeen. The Expence of planting Guns in this Sort of Batteries are mentioned in the ſecond Chapter.

Batteries being faced with a ſufficient Thickneſs of Metal, that is at leaſt equal in Strength to the Metal Cannon-Balls are made of, there can be no Doubt that the Balls fired directly againſt ſuch Batteries will break in Pieces, without making any conſiderable Impreſſion upon the Battery, as may be eaſily proved, by taking a Ball, or if they pleaſe, one Hundred or more Balls of Stone, if a real Trial with caſt Iron be thought too expenſive, and throw them with a ſufficient Force, or fire them out of a Gun againſt a Stone of the Kind, that is but three or four times the Ball's Diameter in Thickneſs, and well back'd with Maſonry, and the Balls will all break, without making any great Impreſſion on the Stone that broke them.

Having ſufficiently explained (to thoſe who are acquainted with Fortification) what Sort of Batteries I think is the beſt for Defence; I will in the next Place deſcribe the Methods I would take in a wet Situation

† It is neceſſary to remember what is ſaid in the foregoing Pages *Chap.* 2, concerning working Guns in theſe Sort of Batteries, where it is repreſented that the Muzzles of Guns are to lie in their Port-Holes, ſomething like a Ball in a Socket, will that turn any Way and not make any Opening.

Situation, to fortify Places (without metal Batteries) ſomewhat different to the preſent uſual Methods.

CHAP. V

IT is pre-ſuppoſed there is always Plenty of Water to fill the Ditches of the Place, ſpoken of in this Chapter, to a proper Height; and alſo Sand, Stones and every other Material neceſſary for the Work, and to be had in ſufficient Quantities.

In the firſt Place, I would have the Covert-Way upon the Surface of the Ground, ſuppoſing the Ground not above four Feet above the Surface of the Water; and if the Place is of Importance enough for the Expence, raiſe Piers upon the Covert-Way about five Feet high, let their Diagonals be nearly perpendicular to the Sides of the Place, Faces of the Ravelins, &c. Lay ſufficient Arches upon theſe Piers, take Earth from where the Covert-way is to be; and from a narrow Covert-way that I would make (within a Foot or leſs of the Surface of the Water) round the Inſide of the arch'd Covert-way, to make a ſufficient Parapet upon theſe Arches over the Covert-way; and make the Glacis with Sand, all to within eighteen or twenty Feet of the Covert-way, and cover the Sand with about a Foot thickneſs of Earth: There muſt be Steps up from under theſe Arches, to within about four Feet of the Top of the Glacis. *See the Plan and Profile of the Covert-way, Plate* VII.

The Ditch to be dug and faced in the uſual Manner; but in raiſing the Works, I would proceed in the Manner following:

Having lined the Side of the Ditch, next the Body of the Place, nearly as high as the Ground; ſet off from the Inſide of the Wall, ſix or ſeven Fathoms inward, and there dig a Foundation about

eight Feet broad, and about two Feet below the Surface of the Water in the Ditch; upon this Foundation make a Wall round the Place as high as the Works are to be, and make an Arch againſt the Bottom of the Outſide of this Wall, for a Gallery quite round the Place, and raiſe the Earth behind the Wall as uſual, for the Rampire and Parapet; then raiſe a ſtrong Wall upon the Lineing of the Ditch, ſo high that the Top of the Parapet have a proper Direction towards the Glacis; and make an Arch againſt the Bottom of the Inſide of this Wall, alſo for a Gallery quite round the Place. Theſe Arches to be made without Mortar, that Water may run freely through them. When this Wall is ſufficiently dry, fill the Space between the Walls with Sand; the ſame is to be done in raiſing the Outworks.

I would make the Inſides of the Outworks of Stones, as much as poſſible, ſo that the Beſiegers may not find Earth in the Outworks to raiſe ſufficient Batteries.

The Flanks to have as much Room in them as poſſibly can be made; I would caſemat two Tier of Guns in the Flanks next the Ditch, the low Tier not more than three Feet above the Water in the Ditch; and if the Height of the Works will admit of it, make a large retired Flank, to fire over the caſemated Batteries mentioned above. The Method to clear caſemated Batteries of Smoke, is ſpoken of in Chap. II.

To defend a Covert-way with Steccadoes or Paliſadoes, I would make vertical Openings at the Bottom of the Breaſt-work or Parapet of the Glacis, in which the Steccadoes is to ſtand, and be capable of lowering or raiſing at Pleaſure; or fix Stocks or ſhort Steccadoes about three Feet and an Half high, or their Tops to be about fifteen Inches below the Ridge

Ridge of the Glacis, and made ſo as to receive a Top of about three Feet and an Half long, ſomething of the Nature of Bayonets upon Muſquets, or they may have a Joint near the Ground, by which Means they may be laid declining one upon another (ſomewhat like the Stalks of Corn blowed down by a ſtrong Wind) that their Tops may lie below the Ridge of the Glacis, and yet be capable of being raiſed in two Minutes that their Tops ſhall be two Foot above the Ridge of the Glacis. It would be Madneſs to the higheſt Degree for Troops to leap over theſe Steccadoes, as there are a Flight of ſteep Steps on the Inſide; it would be ten to one againſt every Man that he will either be killed, or hurt ſo much as to be unable to do any Thing againſt the Beſieged.

REMARKS *on this Method.*

If the Sand that forms the Glacis, were laid at the Foot of the Glacis, as low as the Surface of the Water in the Ditch, it would be better; but as the digging and carrying away ſo great a Quantity of Earth, will, perhaps, be a greater Expence than the Advantage ariſing from it, therefore I have not propoſed it, tho' I know the Earth will be of great Service in making Approaches upon a Glacis of Sand.

The Glacis being a Body of Sand, will coſt the Beſiegers much Labour to make their Approaches (eſpecially in a dry Seaſon, and conſiderable Places are generally beſieged in a dry Seaſon) for the Sides of the Trenches will run together in ſuch Manner, as to render it almoſt impoſſible to make deep Trenches, and deep they muſt be or the Beſiegers will ſuffer extremely; and the continual ſhaking of the Air by the Cannon and Mortars will make the Sides of the Trenches ſlide in more.

I am not unacquainted that much may be done in this Caſe, with Sand-Bags, Faſcines, Stakes, and

other Inventions; but which Way ſoever a Trench of ſix or ſeven Feet deep is made in Sand, it will coſt much more Time than in Earth, for no Man can caſt a Shovel of Sand, let the Shovel be ever ſo ſmall, from the Bottom of a Trench ſix Feet deep upon its Side, (as much Sand muſt be thrown up there before) but the Sand will return into the Trench, except the Beſiegers carry all the Sand firſt taken out of the Trenches to ſome diſtant Places, and heave little upon the Sides of the Trenches.

The Beſiegers may uſe Means to wet the Sand a little, which will make the Sides of the Trenches ſtand up better than when the Sand is dry, but the wet Sand cannot be thrown any conſiderable Diſtance by Shovels; and a Man cannot ſtand in the Bottom of a Trench of ſix Feet deep, and throw the wet Sand ſo far out of the Trench but it will ſlide into the Trench again, except as is ſaid before the Sand that is taken away at the firſt to make theſe Trenches be removed along the Trenches to ſome other Place. To make Saps, Galleries and Mines in Sand will be attended with ſtill greater Difficulties.

The Obſtructions the Parapet upon the Arches on the Covert-way will be to the Beſiegers, and the Defence the Covert-way is capable of making, are mentioned in Chap. III.

The Beſiegers having taken the Ravelin, will endeavour to raiſe Batteries in the Ravelins, or in the Places of Arms, to ſilence the Fire of the Flanks, (but if the Inſide of the Ravelins and Places of Arms are chiefly Stones, covered only with a Thickneſs of Earth ſufficient to prevent the Beſiegers Bombs doing too much Miſchief with the Stones, which Earth the Beſieged may endeavour to throw into the Ditch before they quit the Work) the Cannon from the Place will do much Execution, by making the Stones fly

amongſt

amongſt the Beſiegers all the time they are fetching Earth to raiſe a Battery.

M. *Belidor* and others have, in my Opinion, given ſufficient Directions concerning the Ditches of Places.

When the Beſiegers attempt to make a Breach in the Body of the Place, they will probably endeavour with their Cannon to lodge Miners in the Foot of the Rampier, which they may effect in the Wall of Maſonry; but when the Wall is pierced, and the Miners are got into the Sand, the Water and Sand will fall in upon them and prevent their compleating a Mine there: But

There is a conſiderable Coheſion in almoſt all Sorts of Sand, when it is a little wet or humid, and a round Hole of a conſiderable Diameter may be dug a great Way into many Sorts of Sand, and the Sand hang like an Arch.

The ſhaking of the Wall in piercing it with Cannon, will alſo ſhake the Sand and weaken its Coheſion, and the two Galleries at the Bottom of the Walls will greatly obſtruct the Miners, in their making Mines under the Sand, if it ſhould be found at all practicable; where theſe Galleries are made, many Stratagems may be uſed to obſtruct the Beſiegers Miners, ſome of which will be mentioned hereafter.

When the Beſiegers are preparing to batter the Body of the Place in Breach, employ (by Turns) all the Men unfit for Arms, great Boys, Women, &c. to pour Water upon the Sand between the Walls till the Sand is moderately wet; there are various Methods by which Water may be poured upon the Top of Parapets (over which it will run and ſink into the Sand between the Walls) but I think we need not look for any other Method than the common Fire Engines placed in a Well or Wells made Bomb-Proof on the Capital of each Baſtion, rather near the flank'd

Angle, with a Leathern Hoſe of a ſufficient Length; it may not be amiſs to have alſo a Well or Wells in the middle of each Curtain, by way of Caution, it not being impoſſible to make a Breach in the Curtain by which the Place may be taken.

When the Sand all along the Front or Fronts attacked is moderately wetted, and the Place known where the Breach is deſigned, the Water need only be continued pouring upon the Parapet perpendicular over that Spot, and if Stones are to be had reaſonably cheap, have a ſufficient Number of large Blocks of Stones ready in the Gallery behind the Wall, to fill the Gallery oppoſite to where the Cannon is to pierce the Wall, and where the Miners are deſigned to be lodged. If large Stones cannot conveniently be had, large Pieces of Timber armed with Iron will anſwer the Purpoſe, for the Water running continually upon them will prevent their being burned; and the Iron will a great while hinder their being cut in Pieces; and when the Beſiegers Miners come to clear the Place, in order to make Mines there, they will not be able to move the large Stones, nor the large Timber, till they have a Number of Men and a good deal of Room, which will take a conſiderable Time; and the Water running continually upon them, if the Weather is cold, the Men will not be able to endure, and even in a warm Seaſon the under-Ground Places where Water is continually dropping upon Men, will be very troubleſome and diſcouraging.

Admit they get the Stones, or the Wood, tumbled into a Ditch, I cannot conceive how they can make any Mines, or get through the Sand, the Water continually running upon them, and the Beſieged uſeing every Means to deſtroy them.

It may be ſaid the Beſiegers will beat the Wall down from the Bottom to the Top, and then the Water

Water poured upon the Sand will waſh it into the Ditch; but

The Wall cannot be beat down without the Beſieged's knowledge, and they will ceaſe to throw Water upon the Sand, and the Sand being a little wet will form a ſteep Aſcent, up which a Man cannot climb till the Top of the Sand is lowered; and before the Beſiegers can come at the inner Wall to make a Breach, the Sand muſt be cleared away, and then the Beſiegers have to begin afreſh to make a Breach; all which will require a conſiderable Time.

If the Beſiegers have not a particular Regard to the Galleries at the Foot of the Walls, they will not clear the Sand ſo low as the Gallery, for to do that will coſt conſiderable Time, as the Stones and Rubbiſh of the Wall and the Six or ſeven Fathoms Thickneſs of Sand cannot but make much Rubbiſh, which will lye a great Height before the ſecond Wall, and the Beſiegers may probably only endeavour to pierce the inner Wall at that Height; if ſo, the Beſieged may eaſily make Mines in the arch'd Gallery at the Foot of the outer Wall, and blow up the Breach there; and alſo make Mines in the Gallery at the Foot of the Inner Wall, and blow up the Breach a ſecond Time. The Contrivances that may be made uſe of to defend a Breach are too many to be mentioned here; if the Reader is curious in this Reſpect, he may ſee much ſaid on this Head in Mr. *Muller's Attack and Defence.*

When every particular of theſe Remarks and Works are conſidered, I think it will appear that the Glacis of Sand, the Parapet upon the Arches over the Covert-Way, the inner Parts of the Ravelins, and other Outworks, &c. being made of Stones, and the Sand and Water between the Walls of the Body of the Place, will (altogether) cauſe a greater Loſs than common to the Beſiegers, and oblige them

to ſpend much more time before a Place, than have been ſpent of late in taking the ſtrongeſt.

Much more may be ſaid, and ſeveral more Plans added, to endeavour to ſhew more clearly the Advantages of this new Method (of uſing Metal, &c. to ſave the Cannon and Troops in a fortified Place) has over the preſent Methods of Fortifying; but I leave the further Improvements that may be made in this Sort of Fortification, to ſome abler Engineer, who will make a proper Uſe of what is in the foregoing Ideas here hinted, if there be any Thing in them worth Notice.

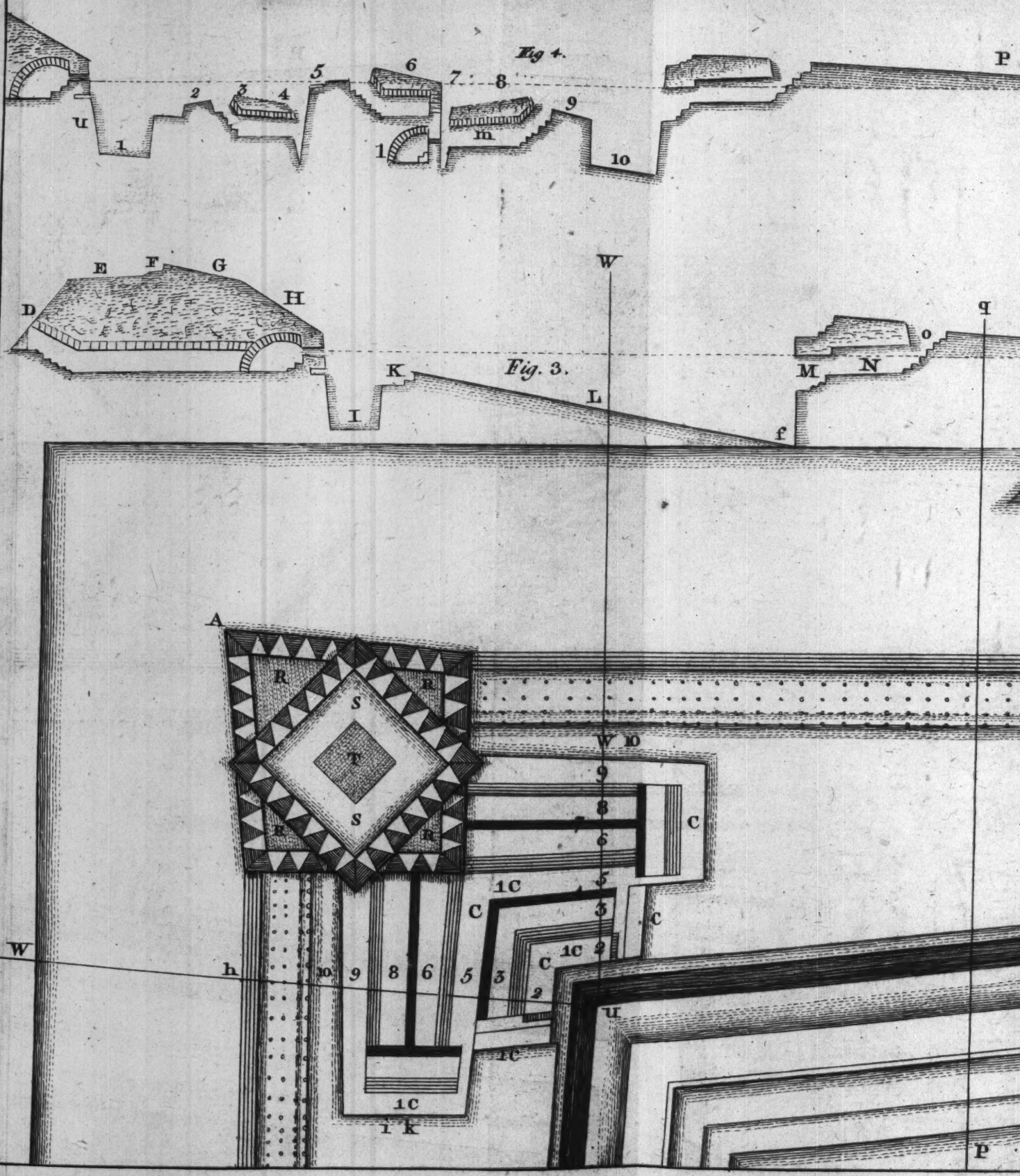
CHAP. VI.

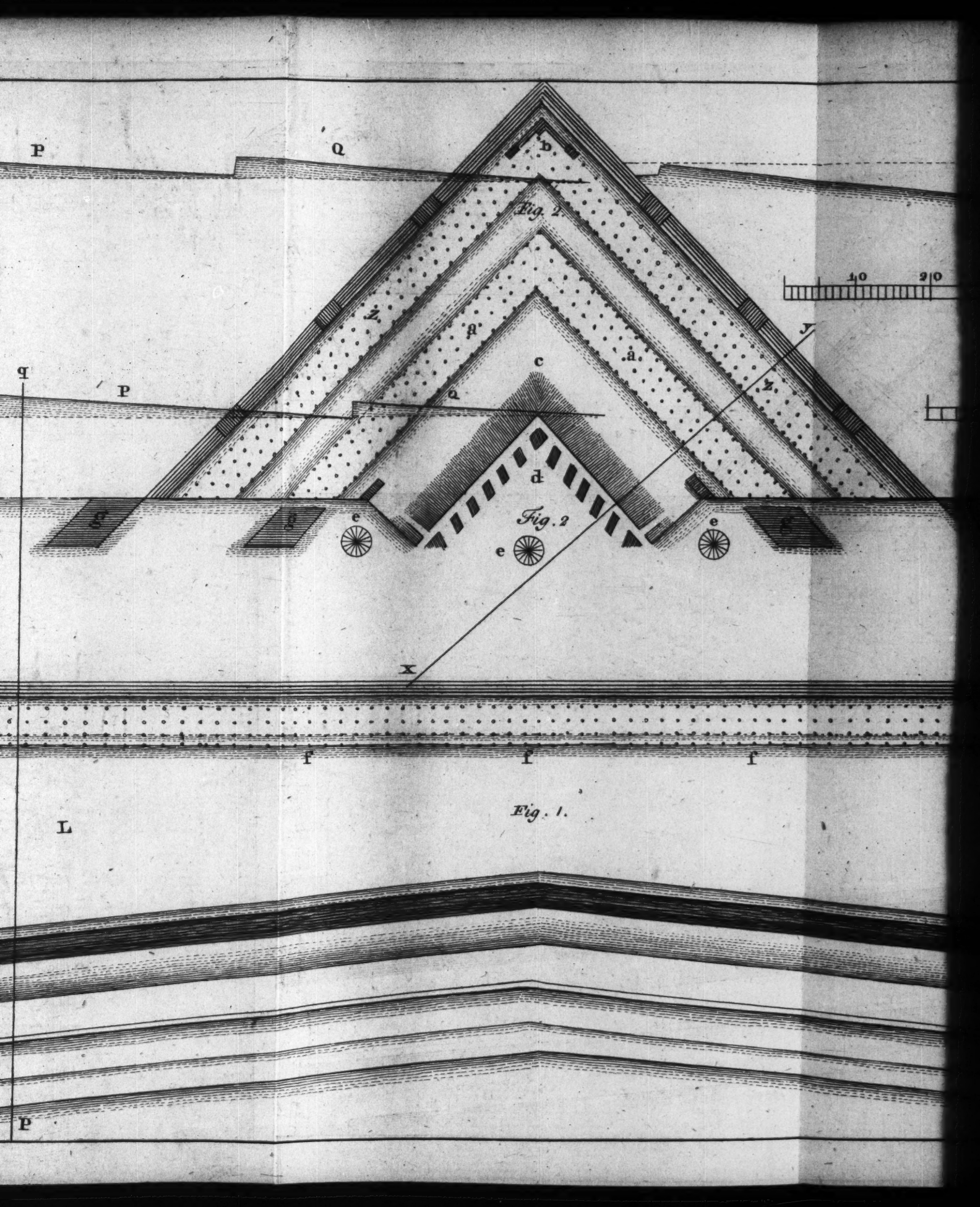
Of the Foundations, and the Manner of laying them.

MR. *Muller* has, in his practical Fortification, treated of the Foundations and the Manner of laying them, to good Purpoſe (in many Caſes;) and as I have had practicable Knowledge, in, almoſt all Manner of Foundations, for above thirty Years laſt paſt, I hope my tranſcribing Mr. *Muller*'s Account of Foundations will not be taken amiſs, as my Intention by making Additions to Mr. *Muller*'s Account, are to improve the Methods in that uſeful Branch.

In order to the better underſtanding the whole, I have inſerted what I ſay upon each Caſe, at the End of what is ſaid upon each Caſe in Mr. *Muller*'s *Practical Fortification.* This Method I imagined the beſt; and what I tranſcribed is diſtinguiſhed, ſo that the Reader will ſee each Part at one View, which being put together, doth probably make the beſt Account of Foundations that is to be met with in any Book now extant.

Plate


Fig 4.
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Fig. 3.
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1C
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P
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b
Fig. 2.
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Fig. 2
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Fig. 1.
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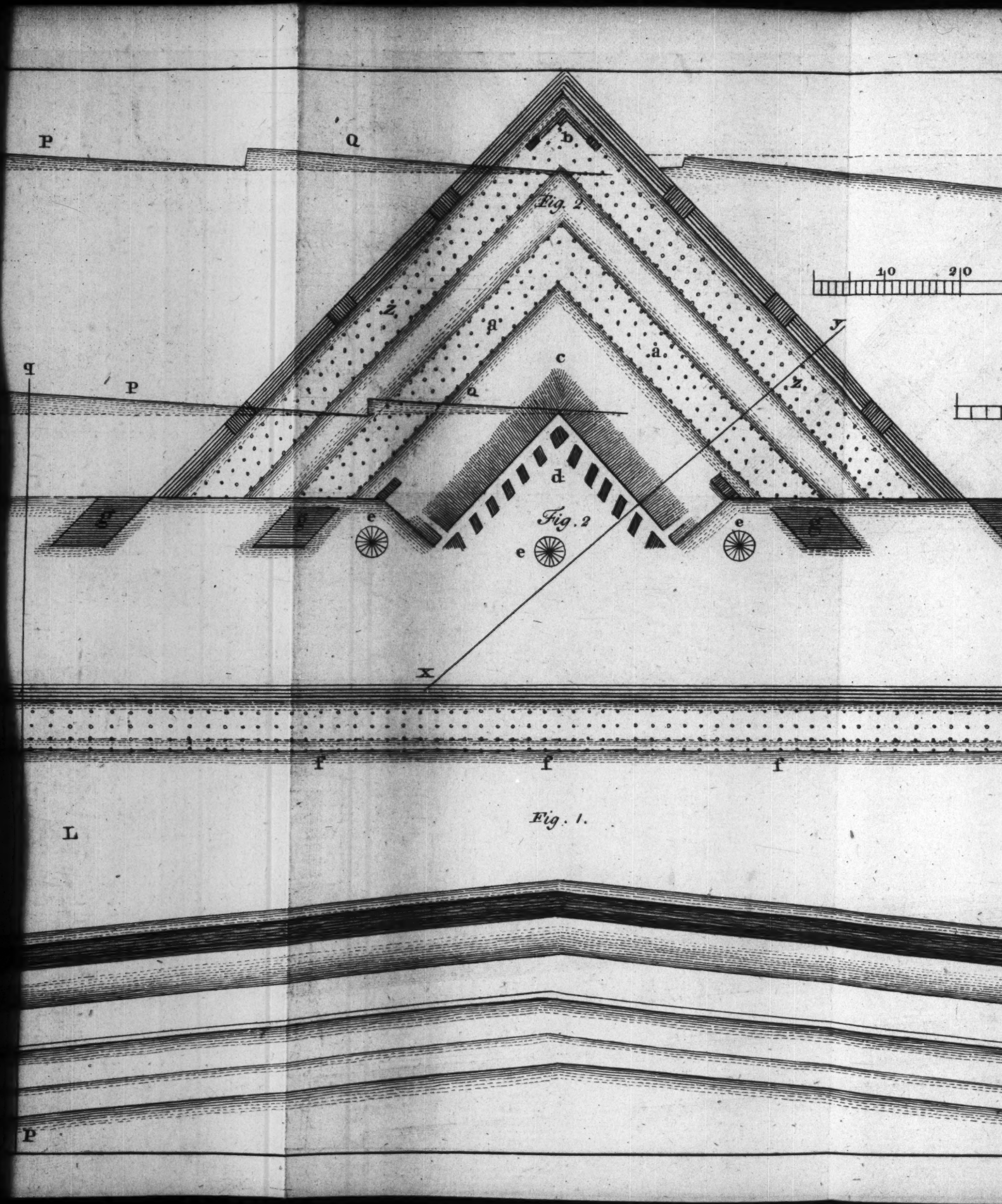
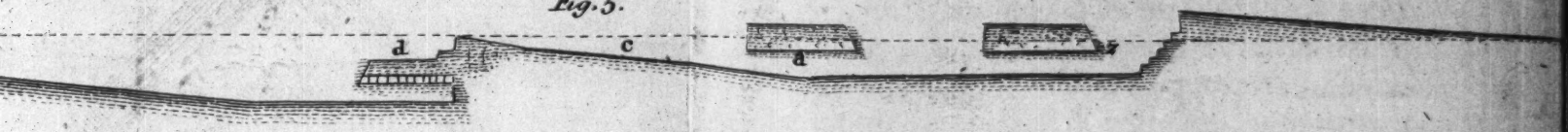
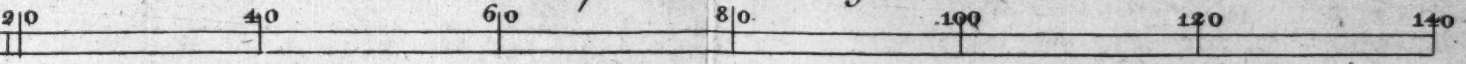

P
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Fig. 2.
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Fig. 1.
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Plate IX

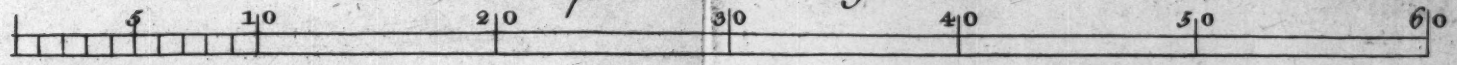
Fig. 5.



Scale of Fathoms to Fig. 1. 2.



Scale of Fathoms to Fig. 3. 4. 5.



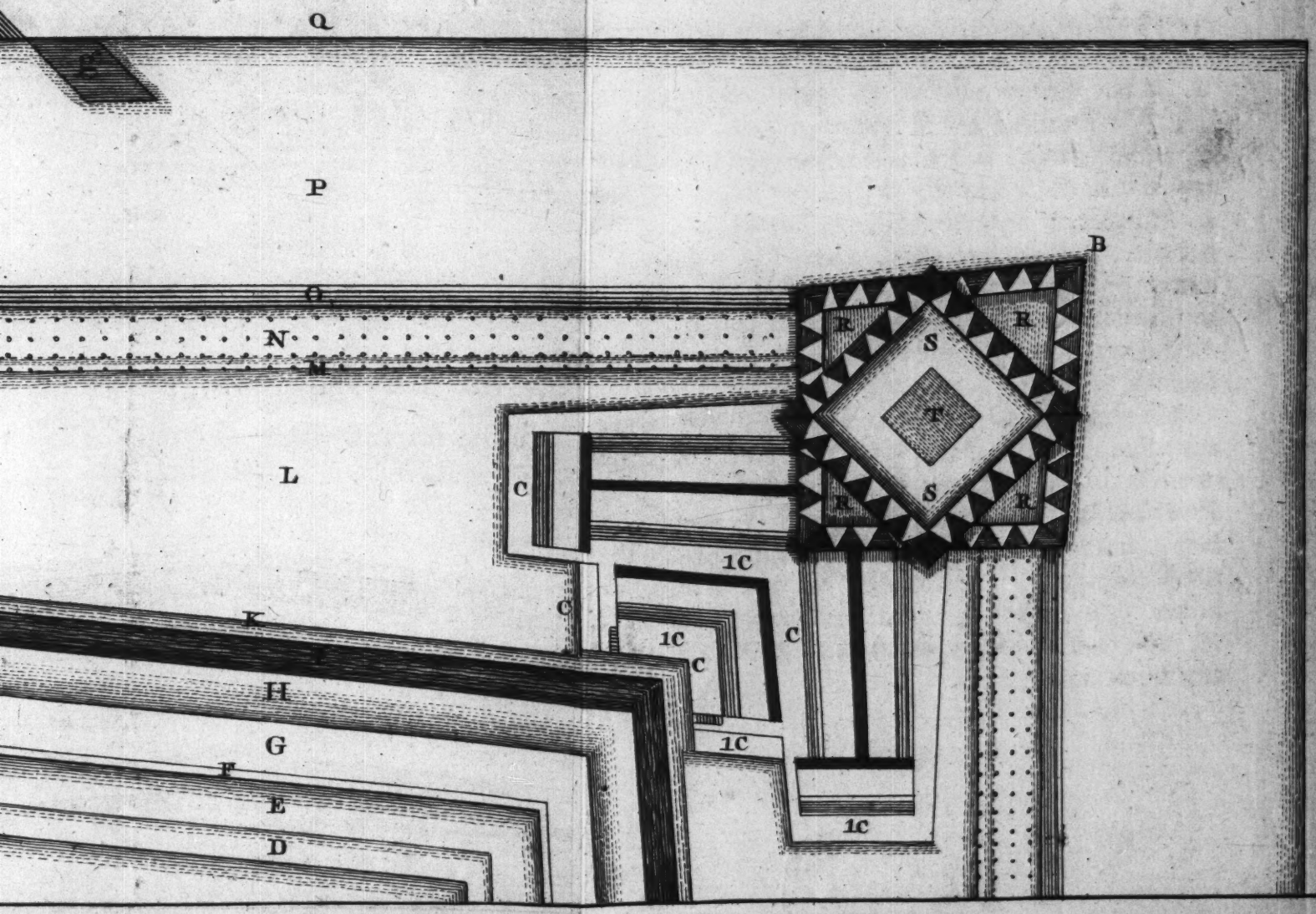


Plate X. " As the Foundations of all Buildings " in general, are of the greateſt Importance, in re- " ſpect to the Strength and Duration of the Work, " we ſhall enter into all the moſt material Particu- " lars which may happen in different Soils, in order " to execute Works with all the Security poſſible; " becauſe many great Buildings have been rent into " Pieces, and ſome fallen down, for want of having " taken proper Care in laying the Foundation; and " for a further Explanation we ſhall join here Plans " and Profiles, adapted to the moſt material Situa- " tions that can be found."

A Deſire to ſee the Structure appear, joined with ſome other Motives, has ſometimes contributed toward making not only the Overſeers, but alſo the Workmen in ſome Degree, endeavour to get much Foundation done, rather than do it well; ſo that the Engineer ſhould be very careful to have his Orders ſtrictly followed in the making Foundations.

" *Firſt.* It is neceſſary to examine very carefully " the Nature of the Soil, upon which the Foundations " are to be built: For doing this, proper Augurs " are uſed to bore in ſeveral Places 10, 12, to 15 " Feet deep, in order to diſcover the Nature of the " Soil, and its hardneſs; or if it is made of ſeveral " Layers or Strates, which is commonly the Caſe, " the Difference of their Nature and Goodneſs; this " is known by their Colour, or the Difficulty of " piercing through them.

" If the Soil be of a good Conſiſtence, for a cer- " tain Depth, without any Water or ſoft Ground, " and this holds ſo all round the Foundation, there " need no other Precaution be taken then to lay the " Foundation four, five, or ſix Feet; only obſerv- " ing to enlarge its Breadth, in Proportion to the " Height of the Walls to be built upon them, ſince " the Higher the Wall is, the more Weight the

" Foundation

" Foundation muſt ſupport: Although this is ſelf-
" evident, yet Engineers do not ſeem to mind it,
" becauſe they make commonly the Baſe of the Wall
" in Proportion to the Depth of the Foundation, and
" not to the Height of the Wall.

" If the Soil be hard Gravel for about ten or
" twelve Feet deep, the Foundation may be built
" upon it, without any Danger of its ſinking; or
" if the Soil be a ſtiff Clay, it will likewiſe be good;
" the firſt and ſecond Figures repreſent the Plan of
" ſuch a Foundation, where there are two or three
" Courſes of large Stones to be put at the Bottom,
" and the Foundation projects by two or three Feet
" before, divided into as many Retreats, but not
" above a Foot behind, becauſe there is no Danger
" of the Wall falling backwards: This is the Cuſ-
" tom; but as for my Part, I think there is no Oc-
" caſion for any Projection at all backwards, ſince
" the Counterforts are ſufficient to ſupport the Wall;
" and this Projection might be of greater Advan-
" tage before, if added to thoſe already mentioned."

The Breadth of the Bottoms of Walls in Fortification, are generally ſomething near a Third of their Height; and the Thickneſs of the Top of the Wall, is, for the moſt Part, about half as thick as the Wall's Bottom at the Level of the Bottom of the Ditch. By Mr. *Muller*'s Tables, a Wall 36 Feet high (Slope $\frac{1}{6}$) is 11 Feet 6 Inches thick at the Bottom, and 5 Feet 6 Inches thick at the Top; the Solidity required in Fortification, makes it neceſſary the Walls ſhould be ſtrong, but there is no Neceſſity to have the Wall this Thickneſs at the Bottom only, to enable the Earth (if clear of quick Sand) to ſuſtain the Weight of a Wall 36 Feet high, as any one may underſtand by inſpecting Stone and Brick Walls, whoſe Height are more than 36 Feet, and their Foundations not 6 Feet thick, and many not above

four

four Feet thick; and ſuch Walls very rarely ſhrink by the Ground yielding under them. By many Obſervations and Facts, I am convinced that there are generally much more Expence beſtowed upon the Foundations in Fortifications than is neceſſary; which I will endeavour to ſhew in the Courſe of this Work.

In a Situation where Water prevents Trenches being made by the Beſiegers in the Ditch, and the Earth is of a common Texture, there can be no Neceſſity to dig and lay the Foundation 6 Feet below the Level of the Bottom of the Ditch; but if the Ditch is dry, I would lay the Foundation 6 or 7 Feet below the Bottom of the Ditch; but the whole Thickneſs of the Wall need not to be ſunk ſo low, only about 5 or ſix Feet Thick, with Retreats, to bring the Wall to about three or four Feet thick, at about a Foot and half (more or leſs according to the Nature of the Ground) below the Bottom of the Ditch, where I would dig the Foundation to its proper Width, allowing for proper Retreats up to the Height of the Ditch Bottom, ſee *Fig.* 9 and 10. This Foundation being properly executed will ſave a conſiderable Expence, and anſwer the End propoſed, as well as if the whole Breadth had been laid ſix or ſeven Feet deep.

I would lay the Foundation with the broadeſt and thinneſt Stones that can be got; taking Care the Joints of every ſucceeding Courſe is at or near the Middle of the Stones in the Courſe next below, not only in the Face of the Wall lengthways, but more particularly croſs-ways in the Wall: This is called by Workmen making good Bend, or Breaking the Joints well. I would build three or four Feet high in this Manner.

" If the Soil be not very firm or hard to a ſufficient " Depth, or when ſome Parts are ſofter than others,

" it

" it will be neceſſary to lay a Grate of Timber firſt " croſsways, and then longways; or ſome lay them " firſt longways, and then croſsways, which ſeems " to be beſt; and well bolted together with wooden " Tunnels, as is repreſented in the third and fourth " Figures: Sometimes, theſe Grates are boarded " over with three Inch Planks, as is marked in the " Profile; at others, large Stones are laid between " the Timbers of the Grate, and laid even with " them, upon which the Foundation is afterwards " raiſed.

" Some Engineers choſe to raiſe the fore Part of " the Grate of about a Twenty-fourth Part of its " Breadth, in order to prevent the Wall from being " overſet by the Preſſure of the Earth, as it has " ſometimes happened. This Precaution ſeems to " me to be very neceſſary, eſpecially when the " Rampart is pretty high; and the Courſes of Stone " in the Foundation ſhould have the ſame Inclinati- " on, excepting the laſt; or the Baſe of the Wall " ought to be level, if thoſe of the Wall are ſo. I " am ſenſible, that ſome Engineers ridicule this " Practice, and ſay, that all Beds of Stone or Brick " ſhould be exactly in a Level; but M. *Coehorn*, who " knew more of this Matter than moſt, if not all our " modern Engineers, has not only laid his Founda- " tions in this Manner, but likewiſe the Walls quite " up to the Top. This is confirmed by l'Abbé " *Dedier*, in his perfect *French* Engineer, where he " ſays, that in repairing the Works of *Manheim*, " which were built under the Direction of M. *Coe-* " *horn*, they found that the Courſes of Maſonry " were perpendicular to the outward Slope, whoſe " Baſe is one ſixth Part of the Height, and the " Walls were only about three Feet thick above, " without any Counterforts. This being the Caſe, " and the Walls being ſtrong enough to reſiſt the

" Preſſure

" Preſſure of the Earth, this Manner of laying Bricks
" and Stones has greatly the Advantage over that
" commonly uſed.

" If the Soil be Sand, and of no hard Conſiſtence,
" the Grateing the Foundation is abſolutely neceſſa-
" ry; or if the Soil be a ſoft Loom or common
" Earth, it is alſo neceſſary to take this Precaution;
" and in general when the Soil is doubtful, though
" not abſolutely bad, a Grating ſuch as this cannot
" but be very uſeful in preventing the Walls from
" ſinking; and I muſt repeat it again, when the
" Wall or Rampart is very high, particular Care
" ſhould be taken to ſecure the Foundation in the
" beſt Manner poſſible; for it is better to do this
" though ſomewhat more expenſive, than to run
" the Chance of making bad Work at an eaſier Rate
" which might prove more burthenſome at the End.

" It is neceſſary to obſerve, that when there is
" any Timber under the Foundation, the firſt
" Courſe of Stones ſhould be made wthout Mortar,
" becauſe its Coroſiveneſs deſtroys the Wood; and
" in general, where any Beams or Timber are laid
" into the Maſonry, inſtead of Mortar, ſtiff Clay
" is uſed round it; and ſome Carpenters make thin
" Caſes of Wood round the parts which enter into
" the Wall.

" When the Foundations are ſo very bad, that the
" Grate of Timber mentioned before, is not ſuffici-
" ent, but is hard after a certain Depth; upon ſuch
" an Occaſion, it is proper to drive Piles, and then
" lay a Grate over them, ſuch as is repreſented by
" the fifth and ſixth Figures: Theſe Piles are to be
" placed exactly under the Croſſings of the Timber,
" to which they are faſtened with Trunnels, and
" are to be drove into the Ground as far as they will
" go.

" As this Method of laying Foundations happens " moſt frequently in the Works of a Fortreſs, and " is very expenſive, Care muſt be taken not to make " any more than what is neceſſary. In order to find " the proper Length of the Piles, one or two are " drove as deep as they will go, and then cut a " certain Number of the ſame Length, and when " theſe are drove, and the Depth of the Foundation " remains the ſame, more are cut of the ſame " Length; but if the Foundation changes, the reſt " muſt be made accordingly. By this Method a " good deal of Timber may be ſaved; whereas, if " the Piles are all cut at once, ſome may happen to " be long, and perhaps ſome too ſhort; which waſtes " a great deal of Timber to no Manner of Purpoſe.

" Some Engineers drive Piles into every Corner " of the Squares formed by the Timbers, and none " under the Frame, as is repreſented here; but this " Method muſt appear to every judicious Reader, " not ſo good as the former, becauſe the Frame is " ſupported by nothing but the Earth, which being " but ſoft, muſt give way to the great Weight of the " Wall preſſing upon the Frame.

" Others drive not only Piles under the Grate, as " we have ſaid above, but likewiſe two in every " Square; that is, in the oppoſite Angles: But it " ſeems to me not worth while to make ſuch expen- " ſive Work without an abſolute Neceſſity, and " when no other Method is practicable.

" Beſides the Piles under the Grating, others are " to be drove at the Outſide next to the Ditch, as " is repreſented in the Plan by the Letter a, their " Number is uncertain, and ought to be regulated " by the Goodneſs or Badneſs of the Foundation. " In both Foundations, repreſented by the third and " fifth Profiles, the outſide Timber next to the " Ditch, ought to be cut in ſuch a Manner that the

" Wall

" Wall may reſt upon Part of it, and the other Part " prevent it from ſliding into the Ditch; or elſe a " ſmaller Timber ſhould be faſtened with Bolts upon " the larger. M. *Belidor* gives an Example of a " Wall ſliding in the Ditch, at *Bergue St. Vinoc* in " *Flanders*, which was the Face of a Ravelin; the " ſame Thing happened ſome Years ago, at our " Wharf here, at *Woolwich*, for the middle Part " of it ſlid five or ſix Feet into the *Thames*, becauſe " the Foundation was only Clay rammed even with " the Bed of the River, and which would have been " ſufficient, had the Precaution abovementioned " been taken.

" We have mentioned before, that ſometimes " Planks are uſed to cover the Grating, and ſome- " times not; where there is Plenty of Stones, theſe " Planks may be ſaved; but in Walls made of Brick " they are abſolutely neceſſary; for they being but " of a ſmall Size, thoſe which reſt upon the Timber " will not be able to ſuſtain thoſe which are between " them.

If the Ground be not very firm to a ſufficient Depth, or when ſome Parts are ſofter than others, I would (the Foundation being dug) drive a Row of dove-Tail Piles, as far as they will go, before the Front of the Foundation, their Heads ſtanding about 6 Inches above the Bottom of the Wall; (which is built cloſe againſt the Inſide of the Piles) where the ſoft Places are, put a String of Oak about 8 Inches by 6 againſt the Outſide of the Piles, about 10 or 11 Inches below where the Bottom of the Stone or Brick Work is to be; cut Openings in the Pile Heads as low as the upper Edge of the String of Oak that is faſtened to the Outſide of the Piles, theſe Openings may be 10 or 15 Feet aſunder, (more or leſs according to the Hardneſs of the Ground;) fit into each of the above mentioned Openings a ſtrong Piece of

Timber with its End about 20 Inches without the Piles, having either a Notch cut, or a Piece of good Timber about four or five Inches thick, faſtened with good Tree-Nails upon the under Side at the End, to take good Hold of the String of Timber mentioned above; theſe Timbers or Sleepers muſt be at leaſt two Feet longer than the Breadth of the Foundation, and have Pieces 5 or 6 Feet long a-croſs the inner Ends, to aſſiſt the Dove-Tail Piles in preventing the Foundation ſlipping forward, and let the outer Ends of the Timbers lie a little higher than their inner Ends, if the Earth-work is carried up along with the Wall.

Lay the Foundation (between the Timbers) upon the Ground with the broadeſt and thinneſt Stones that can be got, and carry up the Foundation 3 or 4 Feet high, with theſe broad Stones as mentioned before, but if broad Stones are not to be had, nor Bricks ſufficiently broad, and the Ground is very ſoft, Planks, or ſomething near equal to Planks, muſt be laid longways upon the Timber; but in this Caſe, when the flat Stones are not to be had, the upper Sides of the Sleepers muſt be laid near 8 Inches below the Top of the Dove-Tail Piles, and the Earth ram'd firm and cloſe, and as high as the Sleepers: If every Sort of Materials are not to be had, the Engineer muſt adapt his Methods of executing the Works to the Materials he can get; but to give a full Account of all the Methods of proceeding, in all the Caſes that can happen in Practice, will take more time than I have in my Power at preſent. When it is neceſſary to cover the whole Foundation with Plank, (and Pileing may be omitted) I would only lay Sleepers in the Manner mentioned above, and lay Planks longways, well tree-nailed upon the Sleepers; this will be a leſs Expence, and not leſs good than a Frame covered with Plank: In Order to underſtand

this,

this, it is neceſſary to conſider that the principal Uſes of Timber and Plank under Walls (that Seas nor Streams doth not run againſt) is to make the Weight of their Foundations lye equally upon the Ground in every Part, and ſecure the Bottom of the Wall that it do not Part, nor ſlip from its Place; now I think every one of Judgment will allow there is little or no Danger that a Wall back'd to its Height with Earth, will fail any Way ſo ſoon as forward. Therefore

The principal Care is to have the Forepart of the Foundation well ſecured, which may be done at a ſmall Expence when the Foundation is making, ſee the Method *Fig.* 9 and 10. As the Walls cannot fail lengthways (except at an outward Angle) I would lay no Timber lengthways in the Foundations (Plank laid lengthways being very ſufficient) except where the Ground is ſo very bad, that Piling is neceſſary the whole Breadth of the Foundation.

When an outward Angle muſt be upon a ſoft Spot of Ground, particular Care is required in making the Foundation, and the more eſpecially ſo, if it is the Epaul or Shoulder of a Baſtion; In this Caſe, the Foundation may be made broader (forward) than the other Parts of the Wall, for twenty or thirty Feet each Way from the Coyn or Angle, and have broader Retreats to bring the Wall ſtraight at the Bottom of the Ditch. If the Ground is very ſoft to a Depth that Piles cannot be of much Service, the Neceſſity is greater to make the Foundation very broad, and lay long Sleepers well covered with Plank, and one or two good Rows of Dove-tail Piles on each Side along the Fronts, with broad Planks laid flat upon the Ground, one without and one within the Dove-Tail Piles lengthways all along; upon which Planks the Ends of the Sleepers are to lie a-croſs and be well faſtened to them with good Tree-nails, but if the

Earth Works are raiſed with the Wall, there need not be Dove-Tail Piles in the Inſide: I would lay this Foundation level, for I think all Foundations ſhould be laid level where the Ground is very ſoft to a great Depth; my Reaſons for thinking ſo are theſe following:

The Inſide of Walls that have outward Slopes, are heavieſt upon the Foundation; and, the Walls whoſe outſide Slope is but $\frac{1}{8}$ when built to their Height, and left to dry ſome Months before any Earth is put behind them, if their Bottoms are laid lower behind than before, in a ſoft Soil will ſettle backwards, notwithſtanding the Counterforts; and if the Soil is ſo ſoft as to riſe or bulge up as the Wall ſettles, the Bottom of the Wall will preſs forward, and the Top incline backward, perhaps too far before the Earth can be raiſed to hinder it; beſides, the laying Earth againſt the Bottom behind the Wall in this Caſe, will add to the Preſſure forward at the Bottom, and make the Top incline backward in Proportion.

If a Row or two of good Dove-Tail Piles are driven a ſufficient Depth at the Front of a Wall, and their Heads ſecured from preſſing outward, the Ground muſt be very ſoft that will not ſupport the Walls without the Expence of piling and laying Frames of Timber in the Foundation; but as nothing but Practice, joined with Art, can make an Engineer a good Judge of Foundations, I would adviſe young Architects to take every Opportunity of ſeeing Foundations of all Kinds: When any very conſiderable heavy Piece of Work is undertaken, I would ſpare no reaſonable Expence to be well informed of the Foundation, eſpecially by conſulting ſeveral of the moſt practical Engineers, tho' ſome of them are fetched five Hundred Miles or more.

" If the Foundation is either all Rock, or only
" partly ſo, the Bed of the Wall is to be ſunk about

ſix

" ſix Inches or ſomething more into it, in the Man-
" ner repreſented in the ſeventh Figure, to prevent
" the Wall from ſliding, which otherwiſe might hap-
" pen, becauſe Maſonry ſeldom binds ſo well with
" the Rock as to make it firm and durable. When
" the Bed is made, Care muſt be taken to ſweep it
" very clean, in order that no Rubbiſh or Duſt re-
" mains in it, and after this, it muſt be wet as the
" Wall is made; by doing ſo, the Mortar will en-
" ter better into the Pores and ſmall Cavities,
" the Maſonry will likewiſe bind with the Rock
" in a more eaſy Manner, and form in time but one
" continued ſolid Stone.

" Although Rock is the ſtrongeſt Foundation
" that can be built upon; nevertheleſs, Engineers
" look upon it as one of the moſt difficult Pieces of
" Work to be met with; their Reaſon for thinking
" ſo is, that they are ſeldom level, but riſe and fall
" continually, by which the Work changes its Pro-
" file at every ſmall Diſtance; and to raiſe the Foun-
" dation to to a proper Level, and bind the Maſon-
" ry to the Rock in a ſtrong and firm Manner, meets
" with the greateſt Difficulty.

" The ſecureſt Manner of proceeding in ſuch a
" Caſe, is, to clear the Rock as well as can be, from
" all Duſt and Rubbiſh, in the Manner obſerved be-
" fore, and to ſink from four to ſix Inches into it; then
" raiſe the lower Parts with good Maſonry made of
" very thin but ſtrong Mortar, ſo as to be in the
" ſame Level with the higher ones. This Work
" muſt be left ſome time to dry and ſettle, otherwiſe
" that Part of the Wall which ſtands upon the made
" Foundation will ſink and break off from the Parts
" which ſtand upon the Rock.

" Sometimes the Rock will riſe at one End nearly
" as high as the Wall itſelf; in this Caſe, the Work
" muſt be raiſed to a Level of about 6 Feet from the

" Bottom, and then left to dry and ſettle for ſome " time; after that, it may be raiſed to the ſame " Height again till ſuch Time as the whole Wall is " finiſhed; and to prevent the Workmen from ſtand- " ing ſtill, ſeveral Parts may be undertaken at the " ſame Time and carried on alternately.

" Sometimes it happens, that the Rock riſes gra- " dually behind, nearly as high as the Wall, or " which is the ſame, that a Wall is to be built a- " gainſt the Rock; in this Caſe, the Rock muſt be " well cleared from all Dirt and Rubbiſh; and if it " is too ſmooth, it muſt be pickt, or ſmall Cavities " made in it, that the Mortar may lay hold of, and " bind it with the Maſonry; and the Work muſt be " carried or gradually and ſlowly, otherwiſe the " Maſonry will naturally ſink and tear off from the " Rock.

" M. *Belidor* propoſes a Method for Building " Walls in this Caſe, which, he ſays, has often been " practiced by ſome *French* Engineers with good " Succeſs; that is, inſtead of uſing common Mor- " tar and Stone in the uſual Manner, they prepare " what is called Stone Mortar; which is made of " thin but ſtrong Mortar mixt with Stones, about " the Size of a Wallnut; a little more or leſs; " then they ſet a kind of Coffer without a Bottom, " cut underneath, ſo as to agree nearly with the un- " evenneſs of the Rock; then this Coffer is fil- " led with Mortar, and let ſtand till it is dry and " pretty hard; then they take the Coffer away in " order to place it elſewhere. The Reader may ea- " ſily perceive, that the Surface of this Mortar is " laid ſmooth and level, and that, when it is well " ſettled, will ſtick much better to the Rock than " any other Kind of Work whatſoever; theſe Kinds " of Walls become in time as hard as Stone itſelf,

" as

" as appears by the Remains of ſuch as have been
" found here, in *France*, and in *Germany*.

" In ſome Parts of *Scotland*, in *Ireland*, at *Gib-*
" *raltar*, and *Mahon*, the Rocks are generally of
" Lime-Stone; in ſuch a Caſe, no better Work can
" be made, than to mix the Stones of the ſame Rock
" with the Lime; this will, by the Likeneſs of the
" Parts, form a Work that will join to the Rock,
" and in time become as one continued Stone.

" It happens ſometimes that under a Bed of
" Gravel, Clay or any other hard Conſiſtence, there
" is a ſoft watery Soil or Sand to a great Depth;
" where it would be dangerous to drive Piles, on
" Account of the Sources or Springs, which are
" generally under theſe Places, which when they
" once get a Vent or Opening, fill the Trench made
" for the Foundation in a ſhort Time full of Wa-
" ter, in ſuch a Manner, as there is no Poſſibility to
" build there. When this happens, a Gutter muſt
" be made to lead the Water out of the Trench into
" ſome Well made for that Purpoſe, if none is found
" near enough, and Engines ſet to work to draw the
" Water out of it into ſome lower Place or Ditch.

" It may happen, that the Water comes ſo faſt
" into the Trench as not to be drawn off; in both
" Caſes, a ſtrong Grate of Timber muſt be made,
" and plank'd over, which being laid over the Foun-
" dation, and faſtened in ſuch a Manner as not to
" ſhift its Place; then the Maſonry is built upon it;
" by which it will ſink gradually till it comes to the
" Ground, and when the Foundation is raiſed above
" Water, it is left to dry and ſettle before the Wall
" is continued.

" I have been aſſured by People of Veracity, and
" Judges of theſe Works, that many ſuch Inſtances
" happen in *Ruſſia*, as well as in *Flanders*, and yet
" when the Walls are finiſhed, they ſtand neverthe-

" leſs

" leſs as firm as if they where built upon a ſtrong " Foundation ; it is certain that theſe Walls will " ſink, but then the Buſineſs is to make the whole " go together without Clinks or Breakings; which " can no otherwiſe be done, than with very good " Materials, and great Care and Induſtry.

" Notwithſtanding that no Water appears above " Ground, and that there is only a hard Cruſt of " five or ſix Feet deep over a ſwampy Soil, yet it is " neceſſary to lay a ſtrong large Grate under the " Foundation, by taking Care to ſink the Trench " as little as can be done, for the Safety of the " Work ; and the Foundation muſt be carried all " round alike by horizontal Courſes, and no new one " begun before the laſt be quite finiſhed; ſo that if " the Ground underneath gives Way, it may be " preſſed alike every where, and ſink together.

" This Method of carrying on the Foundation " alike all round the Work, ſhould be obſerved " every where, excepting on Rocks, or ſuch a hard " Subſtance that cannot give way ; where it may be " done by Parts one after another, only obſerving " to join them well together, and by Steps, that no " two Joints may be over one another.

" There are ſome Situations, which beſides being " ſwampy, the Trench dug for the Foundation fills " in a ſhort time with Water; the Method uſed upon " theſe Occaſions, is, to open only as much of it as " can be made in a Day, and the Stones are laid, " without any other Precaution, on the Ground, and " the Work is carried on as faſt as poſſible, till the " Walls is above the Height to which the Water " riſes ; but this Foundation muſt be made very " broad and by Retreats, and the Stones laid in " Tarras-Mortar, that it may ſoon grow hard ; when " this is done all round, and the Work ſettled, the " reſt is built in the uſual Manner.

" Theſe

" Theſe Kind of Foundations are very common " in *Flanders*; and M. *Vauban* was very much puz- " zled at firſt how to proceed, till ſome Workmen " of the Country, which had been uſed to them, put " him in a Method of it. I have ſeen the ſame at " *Douay*, where they dug a Trench of about 140 " Yards, and three Feet deep; and as faſt as it was " opened, the Maſons worked at the Foundation, " which was raiſed 6 Feet high; though the next " Day half of it was under Water, yet the Work " ſtood as well as if it had been built upon a ſolid " Foundation.

" As the different Situations and Soils require " different Precautions, it is impoſſible to give par- " ticular Methods for every one; the moſt ſecure and " probable by which an Engineer may ſucceed, is, " to conſult the Workmen, who either live upon " the Spot or near it, and who have been employed " in ſuch Foundations; for they generally know beſt " what Method will moſt likely ſucceed; by con- " ſulting ſeveral upon the ſame Subject, if they dif- " fer in their Opinion, which is often the Caſe, it is " the Engineer's Buſineſs to judge what is beſt to be " done, and from his own Experience, joined to that " of the Workmen, deduce the Method by which " he is to carry on his Work: But notwithſtanding " all human Precautions that can be taken, yet Ac- " cidents will happen, which are to be repaired as " ſoon as poſſible, and whereby the Engineer will " learn how to avoid them afterwards, in the Re- " mainder of his Works.

" We have endeavoured to give here moſt of the " ſeveral Caſes which commonly happen in all " Foundations made upon the Land; and which, " if ſtudied with Care, I do not doubt but an Engi- " neer with a moderate Share of Practice and " Knowledge, will be enabled to perform ſuch

" Works

" Works: But the Manner of laying the Foundati-
" ons in Water for Bridges, Sluices, Moles and
" Piers for Harbours, will be treated of ſeperately in
" the latter Parts of this Work, *i. e.* The latter
Part of *Muller's Practical Fortification.*

When every Part of the Foundation is Rock, there cannot be any Danger of Settlement, nor Difficulty in laying the Foundation; but when there are high Pieces of Rocks which ſerve for Part of the Wall, and in ſeveral Places the Ends of the Wall not only joins the Rock and ſets on upon it lengthways, but ſome Part or Parts of the Wall muſt be built againſt the Face of the Rock; in ſuch Caſes, it is ſomewhat difficult (without good practical Knowledge) to make the Work join the Rock ſo as not to ſhew at the Rock and Wall's Meetings ſome Shrinkings of the new Work. The Form of the Rock muſt in a great Meaſure determine the Butting of the Wall againſt it. I would chuſe to make the higheſt Buttings, and conſequently the feweſt the Rock will admit of, without too much Labour; cut the End of the Rock where the Wall is to join it vertical, making the Coyn of the Rock about 75 or 80 Degrees, ſo the Back Part of the Front Stones will be longer than the Forepart (in Nature of a Dove-Tail) and confine the Wall that it cannot ſettle forward; and to prevent the Wall from lowering by the drying of thick Beds of Mortar, the Stones muſt be laid ſo cloſe as the Nature of the Work will admit, without beſtowing too much time. The Wall being raiſed ſo high as the Butting, and, where it muſt be made longer by being ſet upon the Rock at one or both Ends, if Circumſtances will admit, let it dry at the Height of every Butting, before more is built upon it; but,

If there is any great Neceſſity, the Wall may be built to its Height in many Caſes without letting it

ſtand

ſtand to dry, and without any conſiderable Detriment if the Foundation be upon the Rock, and the Weather dry and warm, by obſerving the following Directions:

Let the Stones be dry; but wet their Outſides when they are put into the Mortar, and make all the Beds of the Stones good, and lay thin Beds of Mortar; when the Wall is extended over a Butting, upon the Rock, lay a thick Bed of Mortar under the firſt Stones that lye upon the Rock over the Butt or Joint, that the Wall may not hang upon the Rock by its upper Parts, and ſo not ſtand with its whole Weight upon its Foundation, by which the lower Part of the Wall will be eaſy to pull out, not having the Weight of the Wall above to hold it faſt; if the Wall doth not extend over the Butt or Joint upon the Rock too far, lay long Stones to hang in the Wall and reach the next Butting, and be about half an Inch clear above the Rock, that the Wall is extended upon; put no Mortar between the Rock and this Stone, and the whole Weight of the Wall will be upon the Foundation, and the Wall will ſettle properly.

To build upon a ſoft Foundation, and the End or Ends of the Wall Butt againſt a Rock; follow the above Directions till you come to extend the Wall upon the Rock above the firſt Butting of the Wall and Rock; taking particular Care no Part of the Wall be built to hang upon the Rock, ſo as to hinder its ſettling all together; and when you extend the Wall upon the Rock, let each Courſe overſet lengthways the whole Breadth of the Wall, like the under-ſide of a Flight of Steps, leaving a Space between the Rock and the Wall, that a Man can go in (when the Wall is ſufficiently ſettled) and begin at the Backſide of the Wall, to cloſe the Wall to the Rock, working outward, taking time and Pains to

do

do the Work well, making well faſt every Height to the Work above, with good hard flat Stones and Oyſter-Shells, which is called *pining* among Workmen. There muſt be good Bond made, eſpecially from the back Side of the Wall to the Front: Every good practical Maſon knows how to do this Work to anſwer the End, as well as if the Wall had been carried up altogether.

It is not difficult to build a Wall to ſtand firm againſt the Face of a Rock, if the Rock can be cut in the common Way, let the Face of it be ever ſo irregular and ſlopeing; I could mention ſeveral Methods, but at preſent I will only explain one Method, which I will adapt to the moſt difficult Caſe I can think of, where the Rock can be eaſily cut by the common Methods.

Admit the Face of a Rock is to be built againſt, whoſe Bottom is nearly upon a Line with the Fore-Part of the Foundation, and ſlopes 6, 8 or 10 Inches in every Foot in height, for any Number of Feet, ſuppoſe 6 or 8 Feet high; and at that Height overhangs, or goes upright, or ever ſo irregular 3 or 4 Feet, more or leſs in Height, and the Bottom of the Rock at or above the Surface, ſlopes backward, downward, ſo that no Hold can be got of the Rock for a Foundation; if it is only a Rock of eight or ten Feet broad or thereabouts, an Arch may be ſprung from the Foundation, on each Side, to build the Wall upon before the Rock; but if the Rock is large, the Ground muſt be dug from its Face, and a Foundation made, and if the Rock below is almoſt as far out as the Foundation on each Side, ſo that there is not a ſufficient Breadth for a Foundation to keep ſtrait with the other Foundation; the Foundation before the Rock muſt be laid out farther than the other Foundation a ſufficient Breadth, with broad

Retreats

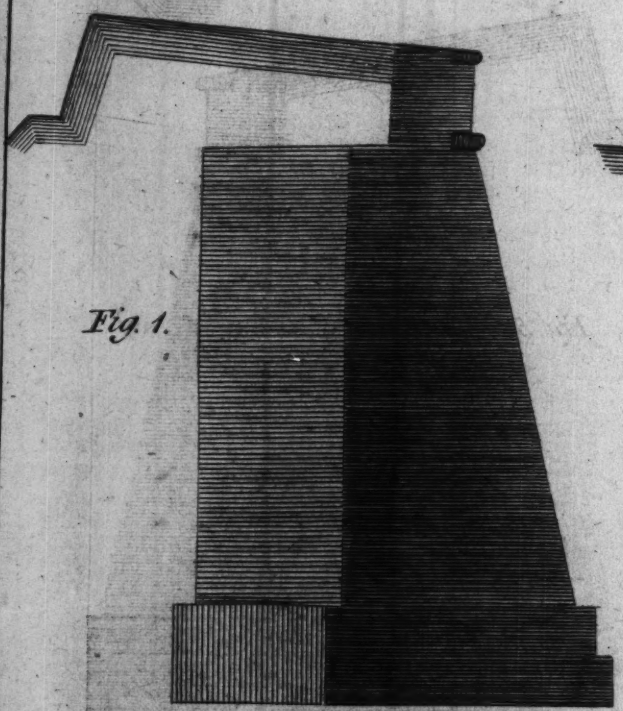


Fig. 1.

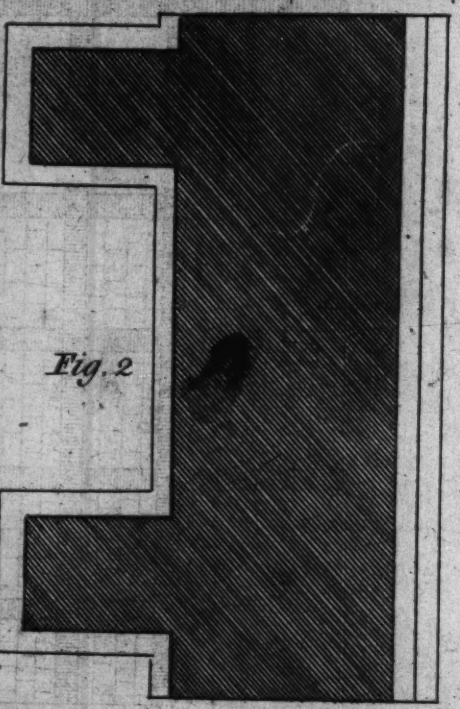


Fig. 2

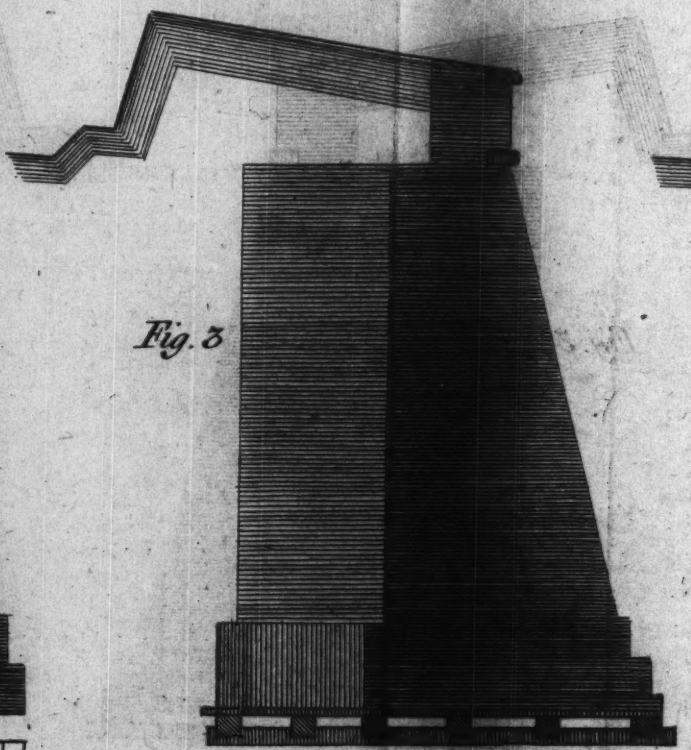


Fig. 3

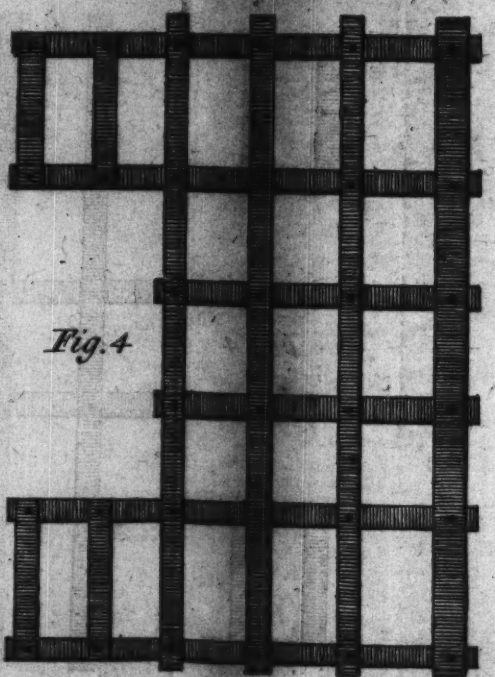


Fig. 4

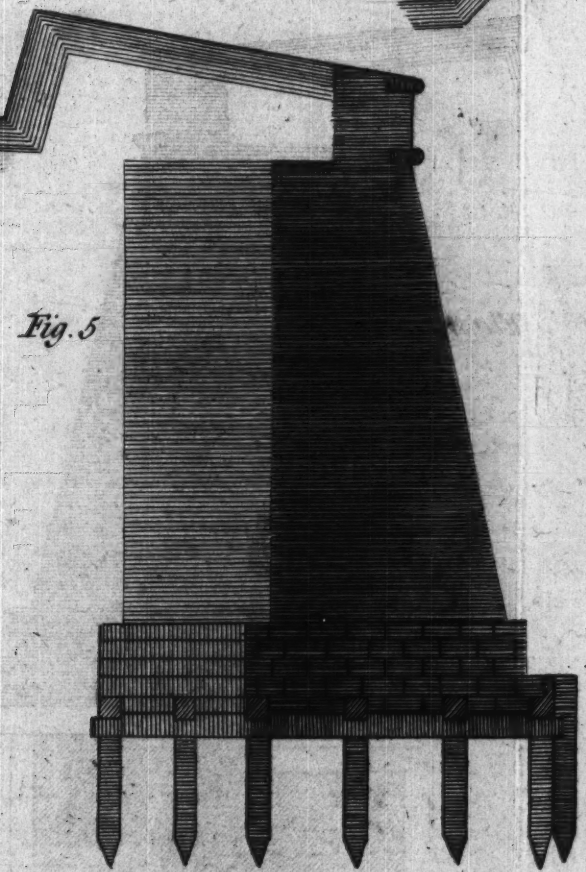


Fig. 5

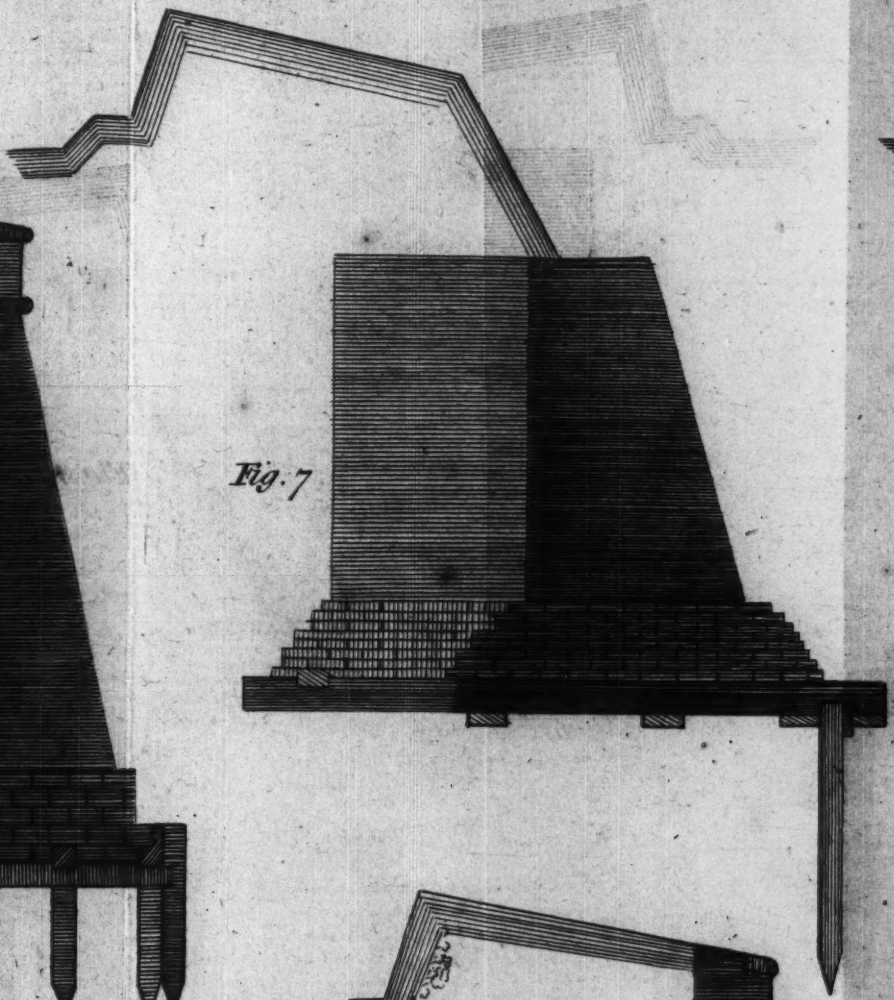


Fig. 7

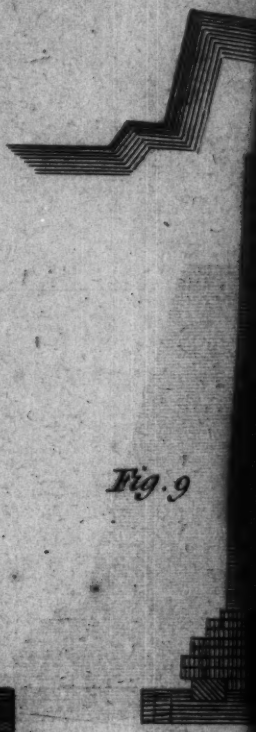


Fig. 9

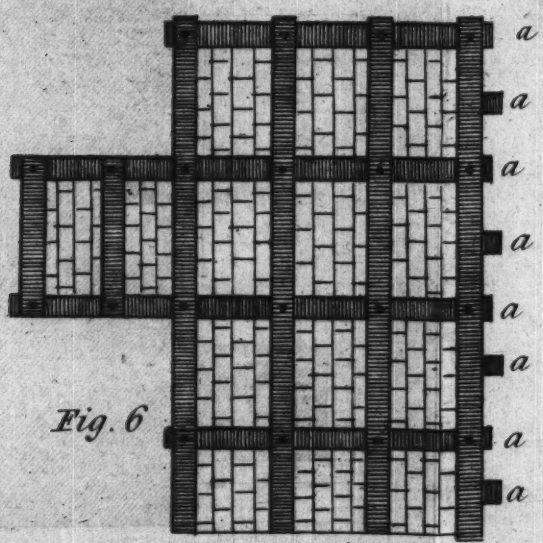


Fig. 6

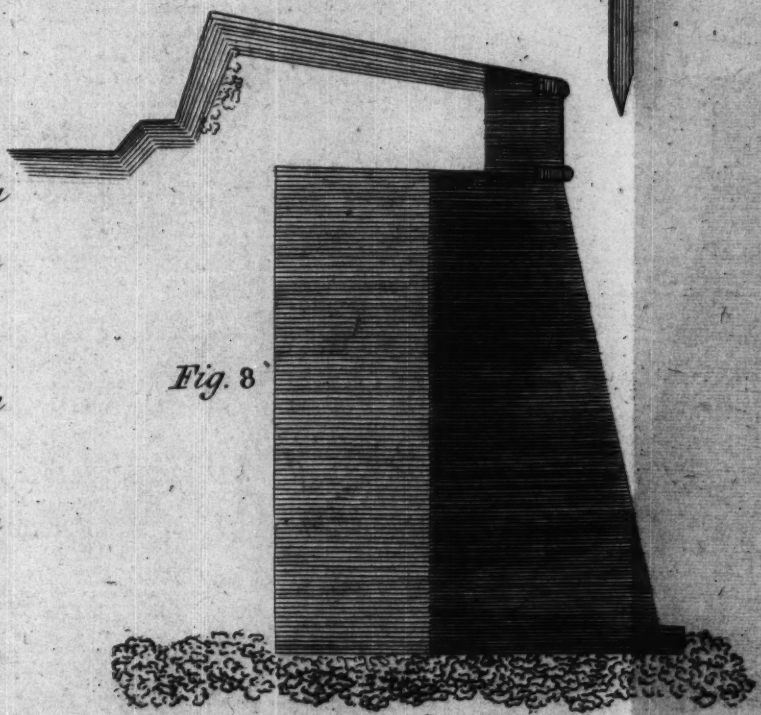
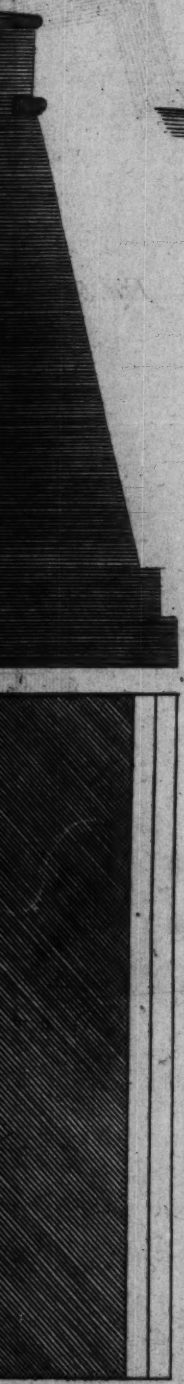


Fig. 8





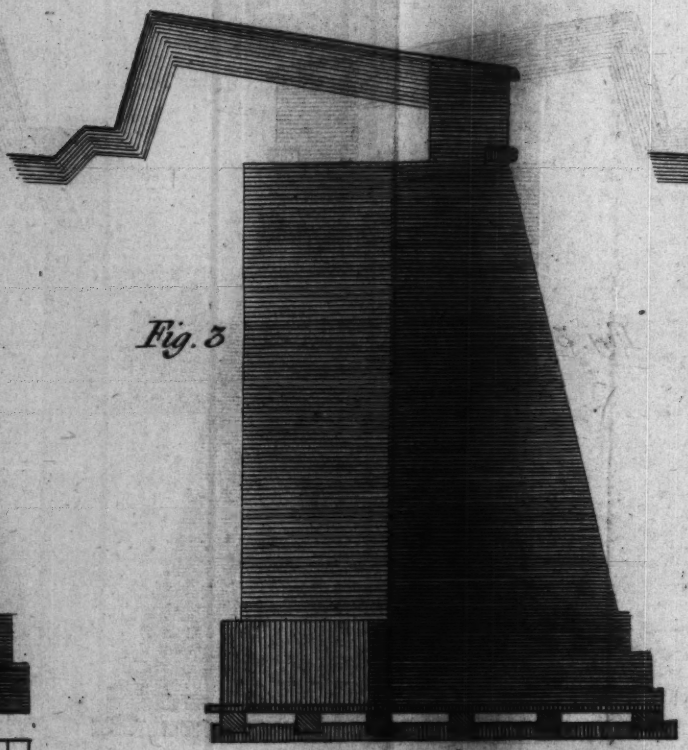


Fig. 3

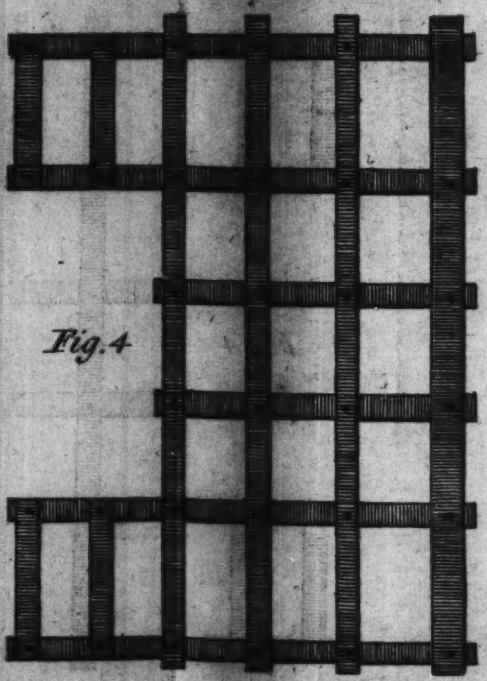


Fig. 4

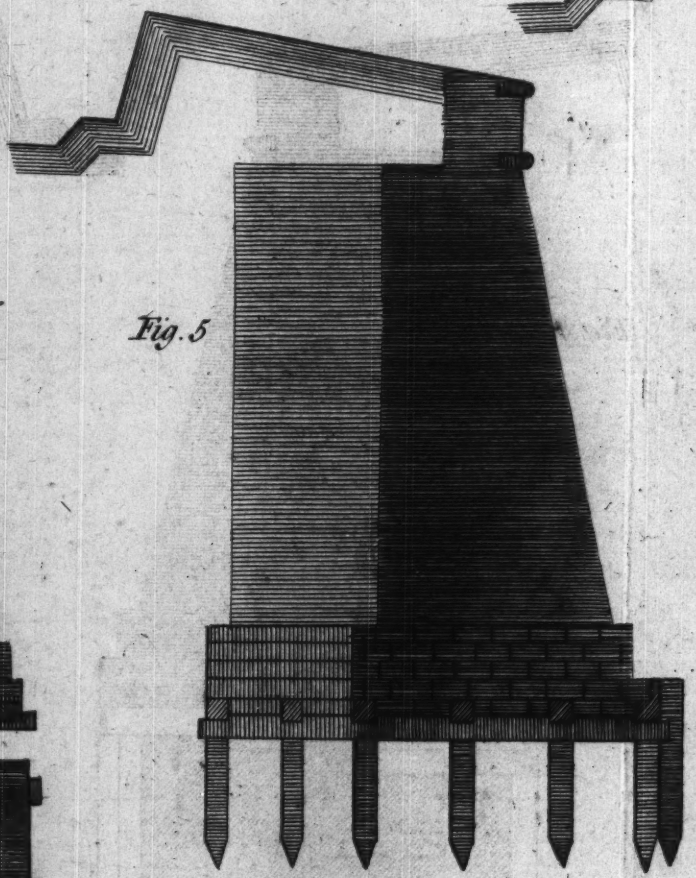


Fig. 5

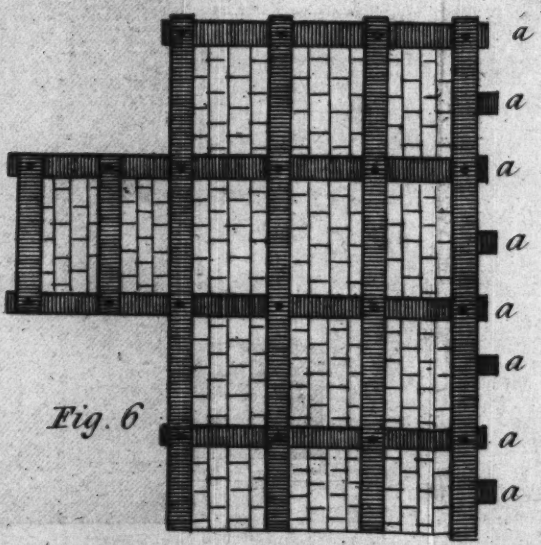


Fig. 6

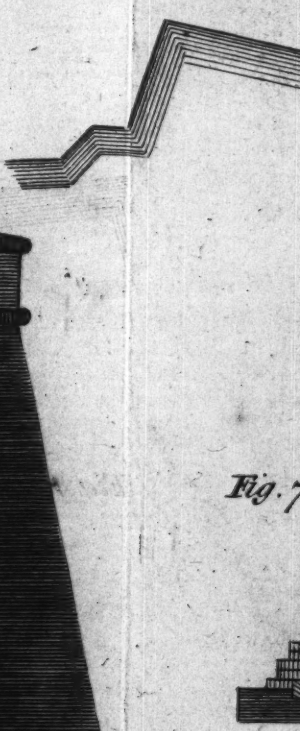


Fig. 7

Plate X.

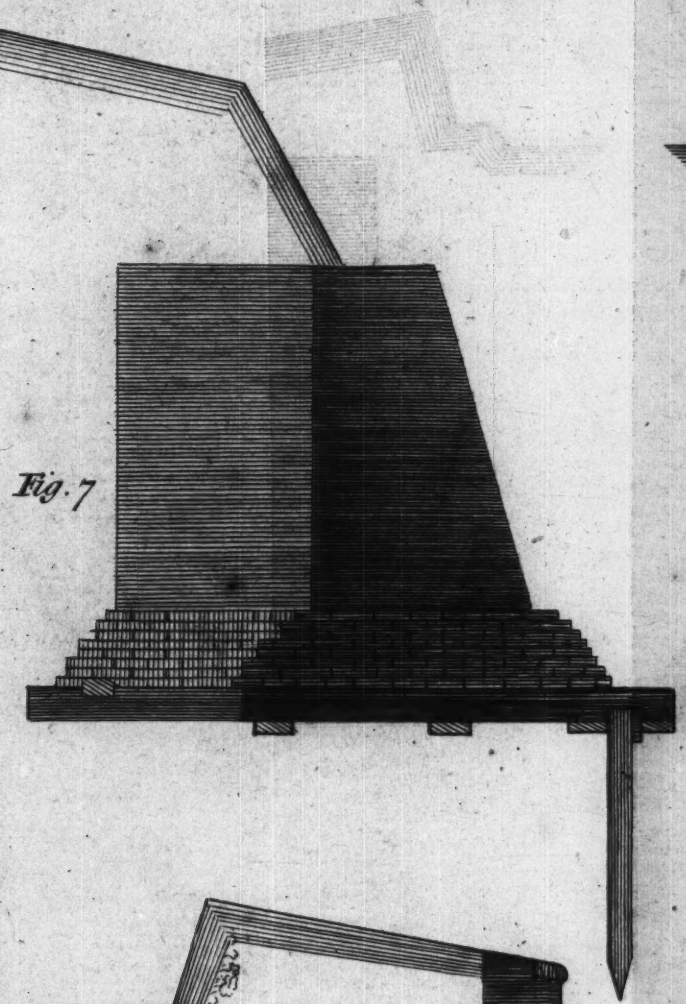


Fig. 7

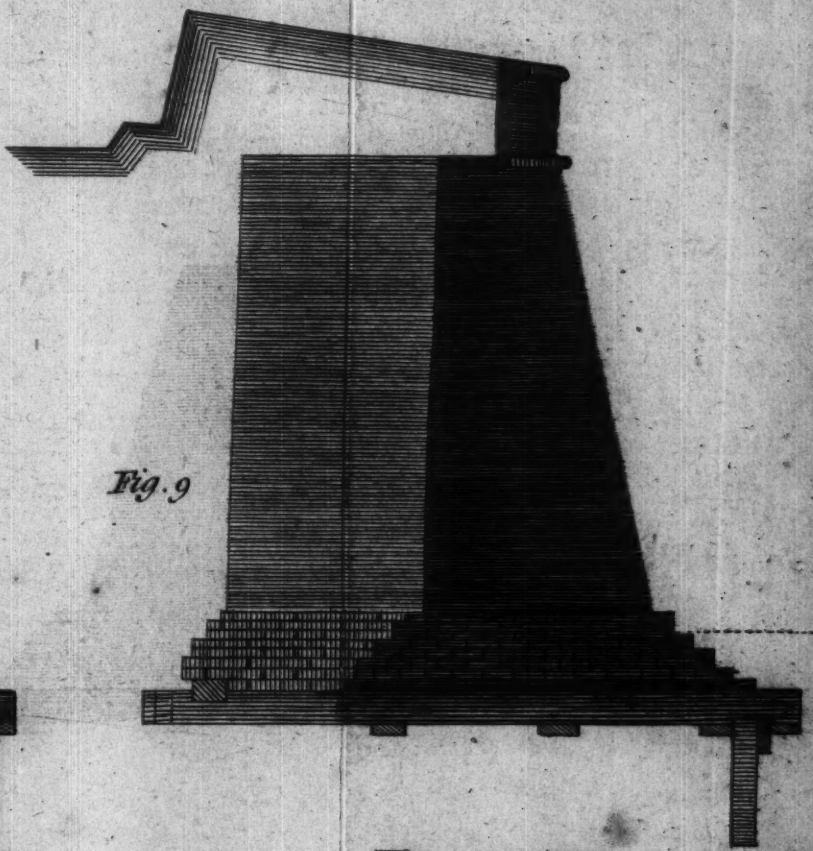


Fig. 9

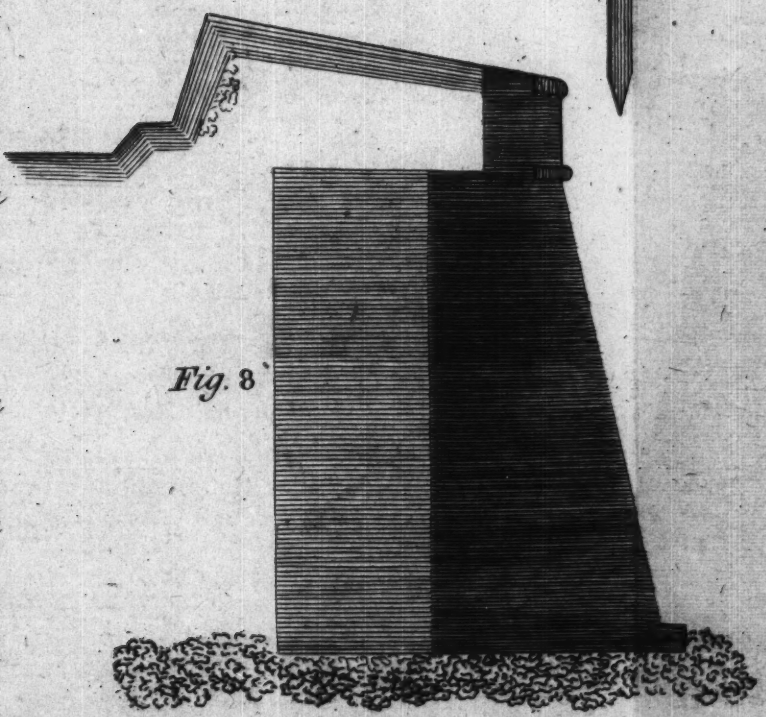


Fig. 8

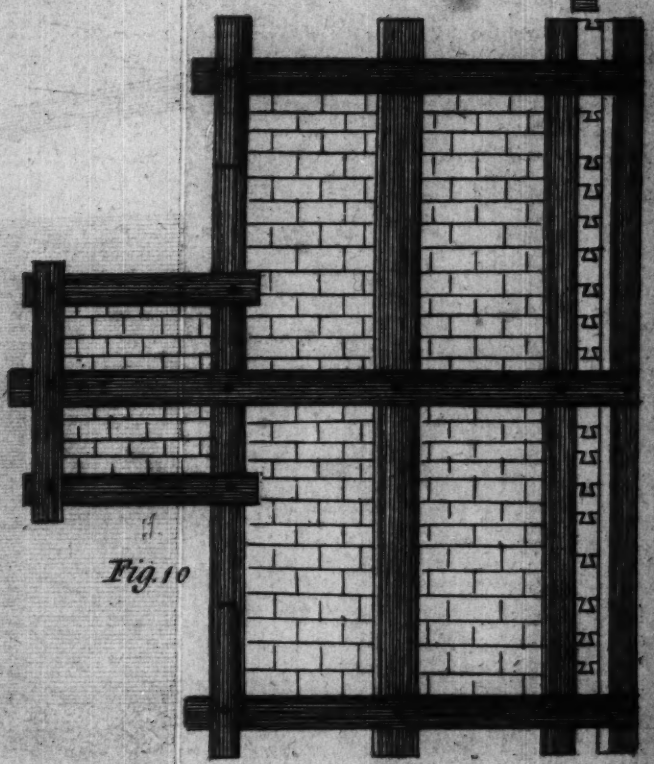


Fig. 10

Retreats to bring the Wall ſtrait at the Surface or Foot of the Rock.

The next Thing to be done is to cut vertical Dove-tail Grooves in the Rock, about a Foot deep, 18 Inches broad at the Bottom, 16 at the Top or Surface of the Rock that is to be built againſt, and about 8 or 10 Feet aſunder; in carrying up the Wall fit long Stones into theſe Grooves (but not cloſe to the Bottom of the Groove,) and let every ſecond Stone reach the Front of the Wall (when you can) and lye upon a Stretcher, till the Wall becomes too thick for one Stone to reach, then lay two or three Stones to reach the Front, taking Care to make very good Bond from the Dove-tails; and if every third Courſe is cramp'd together with Lead, it will greatly add to the Security of the Work. Theſe Dove-Tail Courſes cannot fail of holding the Wall faſt to the Rock; and if Care is taken to keep the Rock very clean, and uſe good Mortar properly againſt the Rock, and pour thin Mortar againſt the Dove-Tails, there cannot be any Doubt of the Wall ſtanding firm againſt the Rock.

Some Rocks are ſo hard that it will coſt much Time and Labour to cut Dove-Tail Grooves; but as they are the beſt Contrivance that I know, I would cut them tho' the Rock be as hard as Marble; but if the Rock be of the Pebble Kind, Drills may be uſed to good Purpoſe to make Taggle-holes in the Rock, to hold the Wall; for I cannot think that even the beſt Mortar will always, and in all Caſes, hold a Wall to a Rock that has a gradual Slope; but Dove-Tail Grooves and Taggles will always anſwer the End if properly executed.

As to the Building Walls formed in Caſes, or Coffers, with thin ſtrong Mortar and ſmall Stones, I can only approve of ſuch Work where good Stone is not to be had at a reaſonable Price. I have obſerved

ſerved old Buildings ſome Part of whoſe Walls are of this Sort of run-Work, and the other Part of common Stone and Mortar built in the uſual Manner; and that Part endures much better that is built with Stone and Mortar in the uſual Manner, as appeared to me upon inſpecting the Walls of *Portcheſter* Caſtle near *Portſmouth*; and the Walls of the City of *Norwich*, and other Places. Much may be ſaid on this Subject; but as I do not in this Place intend to treat of all the Methods of building Walls, I will only ſay, had I a Wall to build with ſmall Stones and thin ſtrong Mortar, I would firſt mould the Materials like Bricks, but much larger, and let them dry, and with them build the Wall in the common Way, as with ſquared Stones and Mortar.

Of Foundations for Piers and Bridges.

Mr. *Mullar* in his practical Fortification, has collected Methods uſed in making the Foundations of Piers for Bridges and Harbours, and I hoping to be uſeful herein have made Additions; but as a full Deſcription of all the Methods that are and may be practiced in Foundations, would alone make a conſiderable Volume, I will here only endeavour to ſhow how Foundations may be made in the moſt difficult Caſes; ſome of which Caſes I have extracted out of Mr. *Mullar*'s *Practical Fortification*, on Purpoſe to ſhew they are looked upon as the moſt difficult Caſes, and ſome of them thought impracticable; but I hope what I ſhall add, will make the moſt difficult Caſes mentioned by Mr. *Mullar*, appear practicable.

CASE I.

After a ſhort Deſcription of the Building of *Weſtminſter*-Bridge, Mr. *Mullar* ſays, "This Method "of building Bridges is certainly the eaſieſt and "cheapeſt that can be thought of, but cannot be uſed

" uſed in many Caſes: When the Foundation is " ſo bad as not to be depended upon without being " piled, or the Depth of Water is very great, with " a ſtrong Current and no Tide, I do not ſee how " it can then be practiſed. For if Piles are to be " uſed, it will be next to impoſſible to cut them off " in the ſame Level five or ſix Feet below the Bed " of the River, notwithſtanding that Saws have been " invented for that Purpoſe; becauſe if they are cut " off ſeparately, it will be a hard Matter to do it ſo " nicely that the one ſhall not exceed the other in " Height, and if this is not done, the Grating or " Bottom of the Coffer will not be equally ſupport- " ed, whereby the Foundation becomes precarious: " Neither can they be cut off altogether; for Piles " are to be driven as far as the Bottom of the Coffer " extends, which at *Weſtminſter*-Bridge was 27 Feet; " the Saw muſt have three Feet play, which makes " the total Length of the Saw 30 Feet; now if ei- " ther the Water is deeper than it is there, or the " Arches are wider, the Saw muſt ſtill be longer; " ſo that I leave the Reader to judge whether this " Method be practicable or not, in any ſuch like " Caſes.

Case II.

" In a great Depth of Water that has a ſtrong " Current and no Tide, the Coffers muſt reach a- " bove the Water, which makes them very expen- " ſive, and unweildy to manage, as well as very " difficult to be ſecured in their Places, and kept " ſteady: So that there is no Probability of uſing " them in ſuch a Caſe.

" In ſome Caſes when there is a great Depth of " Water, and the Bed of the River is tolerably level, " or can be made ſo by any Contrivance, a very " ſtrong Frame of Timber about four Times as " large as the Baſe of the Piers, may be let down

" with

" with Stones upon it round the Edges to make it
" ſink: After fixing it level, Piles muſt be driven
" about it to keep it in its Place; and then the Foun-
" dation may be laid in Coffers as before, which are
" to be kept ſteady by means of Ropes tied to the
" Piles.

" This Method has frequently been uſed in
" *Ruſſia*, as I have been aſſured by a Gentleman who
" has ſeen it. Though the Bed of the River is not
" very ſolid, yet ſuch a Grate, when once well ſet-
" tled with the Weight of the Pier upon it, will be
" as firm as if Piles had been driven under the Foun-
" dation; but to prevent the Water from gulling
" under the Foundation, and to ſecure it againſt all
" Accidents, a Row of Dove-Tail Piles muſt be
" driven quite round the Grating; this Precaution
" being taken, the Foundation will be as ſecure as
" any that can be made.

" The *French* Engineers make Uſe of another
" Method in raiſing the Foundations of Maſonry
" under Water, which is, to drive a Row of Piles
" round the intended Place, nearer to, or farther
" from each other, according as the Water is more
" deep or ſhallow; theſe Piles being ſtrongly bound
" together in ſeveral Places with horizontal Tie-
" Beams, ſerve to ſupport a Row of Dove-Tail Piles
" driven within them; when this is done, and all
" well ſecured according to the Nature of the Situ-
" ation and Circumſtances, they dig the Foundation
" by Means of a Machine with Scoops, invented
" for that Purpoſe, until they come to a ſolid Bed of
" Gravel or Clay; or if the Bed of the River is of a
" ſoft Conſiſtence to a greath Depth, it is dug only
" to about 6 Feet, and a Grate of Timber is laid
" upon it, which is well ſecured with Piles driven
" into the oppoſite Corners of each Square, not

" minding

" minding whether they exceed the upper Surface of " the Grate, much or little.

" When the Foundation is thus prepared, they " make a Kind of Mortar called *Beton*, which con- " ſiſts of twelve Parts of *Pozolano* or *Dutch* Terras, " ſix of good Sand, nine of unſlaked Lime the beſt " that can be had, thirteen of Stone Splinters, not " exceeding the Bigneſs of an Egg, and three Parts " of Tile-Duſt, or Cinders, or elſe Scales of Iron " out of a Forge: This being well worked together " muſt be left ſtanding for about 24 hours, or till it " becomes ſo hard as not to be ſeparated without a " Pick-axe.

" This Mortar being thus prepared, they throw " into the Coffer a Bed of ruble Stone not very large " and ſpread them all over the Bottom as nearly " level as they can; then they ſink a Box full of " this hard Mortar, broken into Pieces, till it comes " within a little of the Bottom. The Box is ſo con- " trived as to be overſet or turned upſide down at " any Depth, which being done, the Pieces of " Mortar ſoften and ſo fill up the vacant Spaces " between the Stones; by theſe Means, they ſink " as much of it as will form a Bed of about 12 Inches " deep all over: Then they throw in another Bed " of Stone, and continue alternately to throw one " of Mortar and one of Stone till the Work approa- " ches near the Surface of the Water where it is " levelled, and then the reſt is finiſhed with Stones " in the uſual Manner.

" M. *Belidor* ſays in the ſecond Part of his Hy- " draulics, *Vol.* II. *Page* 188, That M. *Milet de* " *Montville* having filled a Coffer, containing 27 " Cubic Feet, with Maſonry made of this Mortar, " and ſunk it into the Sea, it was there left ſtanding " for two Months, and when it was taken out again " it was harder than Stone itſelf. Where ſuch Mor-

" tar can be made, this Method has certainly the " Advantage over all the others, not only in Build- " ing the Piers of Bridges over deep Rivers, but " likewiſe for making Piers for Harbours, and in all " other Aquatic Works : But before it is made uſe " of, I would adviſe the Engineer to make firſt a " Trial of his Mortar; ſince Works of this Nature " are of too great Conſequence to be carried on with- " out an abſolute Certainty of Succeſs.

CASE 3.

" We have hitherto mentioned ſuch Situations " only where the Ground is of a ſoft Nature; but " where it is rocky and uneven all the former Me- " thods prove uneffectual; nor indeed has there yet " been any one propoſed that I know of, which " might be uſed upon ſuch an Occaſion, eſpecially in " a great Depth of Water; but as an Engineer " ought to know how to proceed upon all Occaſi- " ons, we ſhall therefore mention ſome few Obſer- " vations under this Head. When the Water is not " ſo deep but the Uneaveneſs of the Rock can be " perceived by the Eye, Piles ſtrongly ſhod with " Iron, may be raiſed and let fall down by Means " of a Machine, upon the higher Parts, ſo as to " break them off Piece by Piece, till the Foundati- " on is tolerably even, eſpecially when the Rock is " not very hard; which being done either this or " any other Way that can be thought of, a Coffer is " made without any Bottom, which is let down " and well ſecured ſo as not to move from its Place; " to make it ſink, heavy Stones ſhould be fixed on " the Outſide; then ſtrong Mortar and Stones muſt " be thrown into it; and if the Foundation is once " brought to a Level, large hewn Stones may be let " down ſo as to lye flat and even; by theſe Means " the Work may be carried on quite up to the Sur- " face of the Water.

CASE

CASE 4.

" But when the Water is ſo deep, or the Rock ſo " hard as not to be levelled, the Foundation muſt " be ſounded, ſo as to get nearly the Riſings and " Fallings; then the lower Part of the Coffer muſt " be cut nearly in the ſame Manner, and the reſt fi- " niſhed as before. It muſt however be obſerved, " that we ſuppoſe a Poſſibility of ſinking a Coffer, " but where this cannot be done, no Method that " I know of will anſwer; and therefore I leave it " to the Judgement and Knowledge of the Engineer " employed upon ſuch an Occaſion, in what Man- " ner he is to proceed."

By the firſt Caſe *Page* 142, it is eſteemed impracticable to make a good Foundation in a conſiderable Depth of Water, where the Ground is ſo bad as not to be depended on without being piled. In order to make a Foundation where it muſt be piled, and the Water is fourteen or eighteen Feet deep; the Place being levelled, drive two Piles at each End, and one Pile about the Middle of each of the Place where the Foundation is to be, as far as they will go; by this Means you'll know the Length of the Piles, and whether there is any conſiderable Difference of the Ground; then prepare Piles and make a Frame or Mould of Timber, whoſe Inſide is made to fit the out Edges of the Platform of Timber you intend to ſink to build upon; ſink this Mould with Iron Piles to its under ſide, like Harrow Teeth about two Feet long, to keep it exactly in the Place where your Pier is to be, which Mould will be a ſufficient Guide to drive your outer Piles; prepare two Mandrels to each Gin of ſtrait grown Oak; each Mandrel muſt have a Socket of Iron to fit exactly the Heads of the Piles; it is eaſy to confine the Socket upon the Pile Head ſo as to take it off under Water, when the Pile is drove; with theſe Mandrells

Piles may be drove in any common Depth of Water, ſo as their Heads ſhall not exceed each other in Height much above a Quarter of an Inch, which is ſufficiently true in Practice, as thoſe Pile Heads that are ſomewhat higher than the others will ſqueeze into the Platform of Timber that is lain upon them; (I have often ſeen Timber taken off Piles, and ſome of the Pile-Heads were ſqueezed near an Inch into the Timber above them; but this was where the Piles were drove in very hard Ground:) Having every Thing ready, ſink the Mould in its proper Place, and drive a Pile into each Corner, to help to keep it in its true Poſition, Places being made clear of the inſide Angles of the Mould for that Purpoſe.

It muſt be obſerved, that the Piles drove in the Angles of the Mould, are to be ſo thick as to have their Heads made ſmaller than the Body of the Pile, to admit the Mandrel Socket on it, and the Pile below the Socket to be at leaſt as large as the Outſide of the Socket, ſo that the Socket of the Mandrel do not ſtrike the Mould, when the Pile is drove to its proper Lowneſs; the ſame is to be obſerved all along the Sides of the Mould; but this need not be obſerved in other Places within the Mould. The Mould being rightly laid, fix a Pile into the Mandrel-Socket, and ſwing the Mandrel perpendicular in Sheers erected for that Purpoſe, and direct the Point of the Pile againſt the Inſide of the Mould near an Angle; then move the Top of the Sheers ſo as to ſlide the Pile Point along the Side of the Mould, till the Angle ſtop the Pile Point; then bring the Top of the Mandrel vertical over the fixed Point, and drive the Pile down; previous to this there muſt be made an exact Mark on the Mandrel to ſhow when the Pile is properly drove down. The firſt Pile being properly drove, let the Mandrel ſtand upon it, and drive a ſmall Pile near it till its Head or Top is level with the

the Mark upon the Mandrel, (this Pile will ſerve to direct the driving of all the other Piles by the Mark upon the Mandrels;) proceed, and drive a Row of Piles quite round the Mould, and you will have the outer Row of Piles finiſhed in the true Form, and ſize of the Platform that is to lye upon them; then drive as many Piles within theſe Piles as is neceſſary; then take up the Mould, and drive a few Piles cloſe to the Outſide of the outer Piles, to direct the ſinking of the Platform you are to build upon with Coffers, or otherwiſe. I think more need not be ſaid to make an ingenious Engineer underſtand how he ſhould proceed to drive Piles under Water, that their Heads ſhall be ſufficiently near a Level.

In order to make a Foundation to a Pier in a great Depth of Water, where there is a ſtrong Current and no Tide (as mentioned in *Caſe* 2. *Page* 143) I would in the firſt Place, ſink a Body ſufficiently large to turn the Current off the Place where the Work is to be done; if the Bodies of old Ships cannot be had, a Break-water muſt be made, with an Angle to part the Current; and the Sides of a ſufficient Length to keep the Current off the Foundation: It will naturally accrue to an ingenious Man how this Break-Water is to be conſtructed, ſunk, and held faſt; wherefore I need only ſay, the Faces of this Break-Water muſt flance out pretty much near the Bottom, to divert the encreaſed Velocity and Weight of the Current, ſo as the Water doth not gull, and ſcower the Bed of the River from the Brea[illegible]-Water's Sides and get under it, and do much Damage. By Way of Precaution, I would put a great Quantity of Stones againſt the Inſides of the Faces of the Break-Water; when one Pier is raiſed above the Water, remove the Break-Water to the next Pier, &c. A Break-Water well fixed, will not only prevent the great Inconveniences the Stream would cauſe in the Works,

but make the Water ſomewhat ſhallower there, eſpecially at the upper End of the Pier; and a Coffer may be uſed in the ſame Manner as if there where little or no Current: As to the Conſtruction of Coffers and the Method of Building in Water with them, I refer the Reader to Mr. *Muller's Practical Fortification*, *Page* 266.

When the Bed of the River is Rock, as mentioned in *Caſe* 3, *Page* 146, and the Water too deep to dry the Rock, and the Rock is very uneven and hard, prepare a large Drill Stock whoſe End is capable to receive a Number of Drills (each about two Inches ſquare) to form altogether a large Drill of about two Feet ſquare, or more, according to the Depth of the Water, and Length of the Stone, that is to be ſet in the Place made level by the Drill; (a Machine being fixed to work this Drill.) Let the Drill down upon the Rock in the Middle of the Spot where the Foundation is to be, and let it ſtand upon its Face, letting the Top incline which Way it will, and you will diſcover by its Top whether that Spot is level; if it is level, the Drill need not be uſed on that Spot; but a Stone muſt be let down, whoſe End is two Feet ſquare, or the Size of the Drill, and length to reach the Surface of the Water; then move the Drill a Foot and half or two Feet from that Stone, and in a Line with it, a-croſs the Work, and the Drill not ſtanding vertical, work the Drill (at firſt gently) till it ſtand vertical; then take the Drill away and let down a Stone as beforementioned: Continue to do ſo till you have got a Row of Stones placed a-croſs the Pier; and the two outſide Stones of each Row is to make the Breadth of the Pier, and Places muſt be drilled in the Rock for each of the outſide Stones, to have ſix Inches hold of the Rock or thereabouts; proceed and place other Rows of Stones in like Manner, about one Foot and Half, or two Feet diſtant, from

from the firſt Row, and from each other, only obſerve that the Stones which form the Outſide of the Pier, are to ſtand as cloſe to each other as can be, and their Ends let into the Rock about ſix Inches, as I ſaid before: The Pier being formed as high as the Surface of the Water by this Method, fill the Diſtances between the Stones with good terras Mortar, and ſmall Stones (it is not in the leaſt material to have the Diſtances between the Stones equal;) then lay a binding horizontal Courſe of large thick Stones, let in five or ſix Inches, and well cramped upon the Tops of the Stones, that ſtands with their lower Ends upon the Rock in the Bed of the River; you may either ſpring the Arches from this Courſe, or raiſe the Piers higher: The above Deſcription may be too conciſe for ſome Capacities, but a Perſon fit to undertake ſuch Works as are here ſpoken of, will eaſily underſtand it. This Method will anſwer in both the 3d and 4th Caſes; for there is no Rock ſo hard, at leaſt that I have ſeen or heard of, but a Drill may be made to pierce it. In this Method there is no need of a Coffer; but in a ſtrong Current a Breakwater muſt be uſed.

The Machine to work the Drill I mentioned above, muſt have four Iron Legs whoſe Length muſt be according to the Depth of Water, with a Contrivance to lengthen or ſhorten any Leg, according to the Unevenеſs of the Place the Legs ſtands upon; the Feet of the Legs to ſtand eight or twelve Feet aſunder at the Bottom, according to the Depth of the Water, and about three Feet and an Half aſunder at the Top, or Surface of the Water, where they go into a Frame of Wood, whoſe Top is between four and five Feet above the Surface of the Water, and has a ſquare Opening within, where Lavers are fixed to work the Drill; (in Nature of a ringing Gin to drive Piles, but that Lavers are added to encreaſe the

the Purchaſe) and which Openings alſo directs the placing the Stones exactly upon the Place the Drill has prepared: Theſe large long Stones are placed by a Crane fixed in a Veſſel for the Purpoſe; where large long Stones cannot be got, ſeveral Stones may be put together to anſwer the Purpoſe of one large Stone.

As to the Method of ſinking a Coffer without a Bottom, and making a Pier within it under-Water with Beton Mortar and ſmall Stones, I muſt acknowledge I do not well know what to think of it, it appearing to me a precarious Method: I have been employed to demoliſh aquatic Works built with Beton or Terras-Mortar, and, ſome Parts were cemented together ſo as the Mortar grew upon the Face of the Wall one Inch or two Thick, and covered all the Joints of the Stones, ſo as the Face of the Wall appeared as one Stone; but again in ſome Places the Mortar had not this Effect, for the Wall was no better in ſome Places than if it had been built with good common Mortar, and, I have often experienced that Beton or Terras-Mortar, tho' made by the ſame Man, took Effect in ſome Places and in other Places miſcarried; as to their being certain Rules to make Mortar that will in all Caſes become hard as Stone, I think there is no ſuch Thing, except a very ſoft Stone is meant; indeed (where the Work is kept dry) ſome Mortar will become hard on the Outſide, like a Skin, not much inferior in hardneſs to ſome common Stone, but this is occaſioned chiefly by being well compacted with the Trowel; but if it is broke into, but an Inch deep, it will be found nothing near ſo ſtrong as common Stone; a ſmall Piece of Mortar may ſometimes be found, that being compared to a ſmall Piece of Stone, the Mortar will appear ſtrongeſt, this may have drawn Men into the Miſtake; and to a meer Theoriſt it will appear ſelf

evident

evident, which conſidered along with the Deſire People have for the Marvellous, and the great Opportunity a Gentleman Theoriſt has above a Mechanick to propogate a Belief, and that too amongſt the upper Claſs of People, I do not wonder at this Notion gaining almoſt univerſal Credit. I would not have the Reader to underſtand that I think it impoſſible to find out a Compoſition that will petrifie, and be hard as a Stone, Nature plainly declares for it; and I have obſerved Petrification, in ſeveral Degrees, both in Clay and Gravel: But I would perſuade againſt a too eaſy Belief of the Strength of Mortar, I having been upwards of thirty Years converſant in all Sorts of Building with Stone and Mortar; and I have ſeen Beton and Terras-Mortar made various Ways, and upon Trial, have not diſcovered any Compoſition that I would depend upon, to form a Foundation under Water for any Pier, though mixed up with ſmall Splinters of Stones, and thrown into a Coffer upon Beds of Ruble Stone.

Of the Foundations of Piers for Harbours.

I have here, as before, tranſcribed the moſt material of what Mr. *Mullar* has collected upon this Head; and ſubjoyned the practical Methods which I would practice, were I employed to lay Foundations of Piers for Harbours, under Water.

" The Manner of laying the Foundation in differ-
" ent Depths of Water, and in various Soils, re-
" quires particular Methods to be followed: When
" the Water is very deep, the *French* throw in a
" great Quantity of Stones at Random, ſo as to form
" a much larger Baſe than would be required upon
" dry Land; this they continue till within three or
" four Feet of the Surface of the Water, where they
" lay the Stones in a regular Manner, till the Foun-
" dation is raiſed above the Water; they then lay

" a

" a great Weight of Stones upon it, and let it ſtand " during the Winter to ſettle, as likewiſe to ſee " whether it is firm, and reſiſts the Force of the " Waves and Winds; after that they finiſh the " Superſtructure in the uſual Manner.

" As this Method requires a great Quantity of " Stones, it can be practiced but in a few Places " where Stones are in Plenty, and therefore the " following one is much preferable. A Coffer is " made with Dovetail Piles of about thirty Yards " long, and as wide as the Thickneſs of the Foun- " dation ought to be; then the Ground is dug and " levelled in the Manner deſcribed in the laſt Secti- " on; and the Wall is built with Beton Mortar, as " has been deſcribed in the ſame Section.

" As ſoon as the Mortar is tolerably dry, thoſe " Piles at the End of the Wall are drawn out, the " Side Rows are continued to about thirty Yards " farther, and the End incloſed, then the Foundati- " on is cleared, and the Stones laid as before. But " it muſt be obſerved, that the End of the Foun- " dation finiſhed is left rough, in Order that the " Part next to it may incorporate with it in a proper " Manner; but if it is not very dry, it will incline " that Way of itſelf, and bind with the Mortar that " is thrown in next to it; this Method is continued " till the whole Pier is intirely finiſhed.

" It muſt likewiſe be obſerved, that the Piers are " not made of one continued ſolid Wall; becauſe in " deep Water it would be too expenſive; for which " Reaſon, two Walls are built parallel to each other, " and the Interval between them is filled up with " ſhingle, Chalk and Stone: As theſe Walls are " in Danger of being thrown out or overſet, by the " Corps in the Middle, together with the great " Weight laid at Times on the Pier, they are tied " together by croſs-Walls at every thirty or forty

" Yards

" Yards Diſtance, by which they will ſupport each " other in a firm and ſtrong Manner. For want of " theſe Croſs-Walls it has happened, not many " Years ago, that the Walls of a Work were over- " ſet for the Space of ſome hundred Yards.

" If ſuch Mortar can be made as what the *French* " call *Beton*, there can ſcarcely be found a better " Method than that above, for laying Foundations " in deep Water, and it may be uſed upon all " Occaſions; but as ſuch Mortar is not every where " to be had without great Expences, I imagine that " common Terras-Mortar, mixt with ſmall Stones " and ſome Cinders, if to be had, will anſwer the " Purpoſe as well; but the Engineer, who is to " carry on the Work, ought to make Trial of it " before he uſes it.

" If the Foundation be bad to a great Depth, I " would ſink it only about four Feet below the " Bed of the River; and lay a ſtrong Grate of " Timber, as in thoſe of the Piers of a Bridge; but " if it ſhould be rocky, a Coffer muſt be made " without a Bottom, and the under Part cut nearly " with the ſame Riſings and Fallings, according to " the Manner mentioned in the laſt Section.

" In a Country where there is a great Plenty of " Stones, Piles may be driven in as deep as they will " go, at about two or three Feet Diſtance, and " when the Foundation is ſunk and levelled, large " Stones may be let down, which will bed them- " ſelves; but Care muſt be taken to lay them cloſe, " and ſo as to have no two Joints over each other, " and when the Wall is come within Reach, the " Stones muſt be cramp'd together.

" Another Method practiced, is to build in " Coffers, much after the ſame Manner as has been " done in Building the Piers of *Weſtminſter*-Bridge; " but as in this Caſe the Ends of the Coffers are left

" in

" in the Wall, and prevent their Joining ſo well as " to be Water-Tight, the Water that penetrates " through and enters into the Corps, may occaſion " the Wall to burſt and tumble down. Another In- " conveniency ariſing from this Manner of Building " is, that as there are but few Places without " Worms, which will deſtroy Wood wherever they " can find it; by their Means the Water is let into " the Pier, and conſequently makes the Work liable " to the ſame Accident as has been mentioned " above.

" To prevent the Inconveniences of this Method, " I would take the Wood away, and joggle the " Ends of the Wall together with large ſtones, and " pour Terras-Mortar into the Joints; when this is " done, the Water between the two Walls may be " pump'd out, and the void Space filled up with " Stone and Shingle as uſual: Or if theſe Joggles " cannot be made Water-tight, ſome Dove-Tail " Piles muſt be driven at each End as cloſe to the " Wall as can be done, and a ſtrong ſail-Cloth put " on the Outſide of them, which, where the Water " is pumpt out, will ſtick ſo cloſe to the Piles and " Wall, that no Water can come in. This Method " is commonly uſed in *Ruſſia*, as I have been inform- " ed."

Before an Engineer forms his Method of proceeding in Foundations, it is abſolutely neceſſary he know the Depth of Water, the Nature of the Ground, and what Materials he has to uſe, and what Trouble he is like to meet with from the Agitation of the Water; whether the Seas run ſquare or oblique to the Direction the Pier is to be built in, &c.

Admit a Pier is to be built in Water twenty Feet deep, and the Ground is ſoft, prepare a Machine that will lower any Weight under forty Tuns; and when the Pier is carried out from the Shore to

where

where the Water is too deep to build any farther in the common Manner, make the End of the Pier ſlope, or fall back about one Foot and an Half in every two Feet in height, then place your Machine fair to this Slope, in order to lower a Pile of Maſonry, which is to ſlide down againſt the ſlopeing End of the Pier, till it ſtand upon the Ground (at the Bottom of the Water.) It is to be obſerved that this Pile of Maſonry is to lay Part of its Weight againſt the ſlopeing End of the Pier, as well as upon the Bottom, I think every Pile of Maſonry may add three Feet to the Length of one Side of the Pier, and another ſuch Pile of Maſonry, add three Feet of Length to the other Side of the Pier; and each Pile of Maſonry make ten Feet Thickneſs of Pier at the Bottom, and five Feet at the Top, or Surface of the Water, (where a new Foundation about ten or twelve Feet broad muſt be made on each Side upon the Tops of thoſe ſunk Piers of Maſonry;) *i. e.* Every Pile of Maſonry ſunk for a Foundation, to be three Feet thick, ten Feet long at the Bottom, and five Feet long at the Top, and as high as the Water is deep, which here is ſuppoſed twenty Feet. This Pile of Maſonry with the Timber under it, ſuppoſing ſixteen cube Feet to a Tun, will weigh near Twenty Eight Tuns: It is eaſy to faſten Hooks to the Bottom of the Piles (to lower it) that may be hawled looſe when the Pile is at the Bottom; I would have thick Pieces of Timber put a-croſs under the forepart of the Timber that is under each Pile of Maſonry, to keep the forepart of the Work well up.

When Pieces of Timber are put upon the Bottom of the Frame (if neceſſary to make it fit the Ground; but the Bottom of the Pile covers ſo little Ground, the Ground muſt be very uneven to require levelling) and every Thing is ready, fix the Frame of Timber on the Hooks, and place its Edge to the

Top

Top of the Slope, againſt which it is to be lowered to ſlide down to the Bottom. When one Courſe of Stone is laid, lower it till the upper Side of that Courſe is a proper Height to receive another Courſe upon it, and ſo continue to lower the Pile of Maſonry into the Water, as you build it ; (the Friction in ſliding down againſt the ſlopeing Stone-Work, and what the Water bears, will take off a conſiderable Quantity of Weight.) Care muſt be taken to lower it equally, and which ever End touches the Ground firſt, that Chain or Rope muſt be ſlacked away, and the other held faſt, till that End of the Pile is ſunk into the Ground as far as it will ; a Row of Dove-tail Piles muſt be driven along each Side of the Pier by Mandrils, in the Manner mentioned before, *Page* 148, where the Foundations of Bridge-Piers are treated of.

I have ſaid the Piles of Maſonry are to make ten Feet Thickneſs of Pier at the Bottom, on each Side, but I would not have the Reader underſtand that the Timber under the Maſonry ſhould be only ten Feet long, I would have the Timber under the Piers of Maſonry about eighteen Feet long, and a croſs-Piece of Timber ſtrongly faſtened upon the upper Part, near the Ends of the Balks, that the Ruble Stone, or other Matter that makes the middle Part of the Pier, may lie heavy upon the inner Ends of the Timber, and in ſome Meaſure ſecure the Foundation from ſliping forward ; (as neceſſary Helps will occur to every ingenious Man.) It is ſcarce worth mentioning that I would lay a large Hull of an old Ship, or two, before the Work, to keep the Water ſmooth when it is working Weather ; but when the Water is much agitated (and the Foundation is in the Sea) the Foundation cannot be worked at.

To

To ſink or dig a Foundation for an Harbour-Pier three, four, or ſix Feet below the Surface of the Ground, in ſix or eight Feet or more Depth of Water, muſt be attended with a more conſiderable Expence than two Rows of Dove-tail Piles; and I think two good Rows of Dove-Tail Piles, are a greater ſecurity to the Foundation, than its being laid three or four Feet below the Surface of the Ground; for the Digging a Foundation below the Surface, can anſwer only two Purpoſes for the Good of the Pier, *i. e.* prevent the Water from undermining the Pier, and hinder the Foundation from ſlideing from its Place, both which Purpoſes will be anſwered as well, by driving a good Row of Dove-Tail Piles on each Side the Fortification; and in the Caſe of preventing the Water undermining the Pier, will anſwer better: As to the Ground bearing the Pier better, when the Foundation is let three or four Feet into it, is little better than a ſuperficial Piece of underſtanding; for, Pier Foundations are generally conſiderably broader than the Height of the Pier, and ſome Piers are twice as broad as high: The Ground is very ſoft indeed that will not bear a Wall whoſe Baſe or Foundation is about 40 Feet broad, and Height only about 25 Feet at moſt; I therefore conclude, That the principal in laying Foundations of Harbour-Piers, is, to ſecure the Foundations from being undermined by the Water. This Method of ſinking Stone-Piers, can only be practiced where Plenty of good Stones can be had.

I have dwelt the longer upon this Head, becauſe I have ſeen great Expence beſtowed in Foundations which might have been ſaved, without any Prejudice to the Building: I beg leave to mention one Caſe:

Upwards of thirty Years ago, I was employed as a Workman, in Building a Stone Pier, which Pier is about forty-two Feet thick at Bottom, and about twenty

twenty Feet high, and ſtands upon very hard ſtony Ground; the Engineer ordered five Rows of Piles to be driven under the Foundation, on each Side the Piers, near the Fronts, and about two Feet apart, and Oak Sleepers (at firſt) from fourteen to twenty Inches broad, laid Lengthways upon the Heads of thoſe ten Rows of Piles; the Space between the Sleepers were well filled with flat large Stones; then ſtrong Balks from fifteen to twenty Feet long, laid on each Side the Pier, cloſe together (like a Platform) croſswiſe upon the Sleepers, and well tree-nailed down to the Sleepers: Little or nothing more could be done, ſave driving two Rows of Dove-Tail Piles, and binding the Timber together in the Middle, to have a Foundation upon the ſofteſt Ground that ever was built upon.

There was more than double the Expence beſtowed, that would make a ſufficient Foundation upon that Ground, and yet this Foundation, notwithſtanding all the Expence, was not ſufficient, as has appeared ſince; for the front Piles, as well as the others, ſtood about two Feet apart, ſome more, ſome a little leſs; and when the Channel by the Pier ſcowered deep, the Stream being very ſtrong, and getting in among the Piles, where meeting Obſtructions, ſcowered away the Ground and Piles, and a Part of the Pier, fell into the River; for many of the Piles (tho' well ſhod with Iron) bruiſed below, and had not drove three Feet. The Ground is very ſtrong, but very Subject to ſcower away, being a Body of great and ſmall Stones, but chiefly Stones like Pebbles, made ſolid by Sand and Gravel being waſhed in amongſt them, ſo that it formed a Body almoſt as ſtrong as Rock to bear a Burthen, but eaſily undermined by a ſtrong Stream; ſo the only Care required was to keep the Stream from getting under the Pier, which a ſingle Row of good Piles driven cloſe

cloſe together along the Foreſide of the Pier would affected; and as there was Plenty of excellent flat broad Stones to lay the Foundation, there was no need of a ſtrong Platform of Timber.

Some Years after, I had the Direction of making a Foundation upon the ſame Ground, and adjoining this Foundation abovementioned; and becauſe I did not drive Rows of Piles under the Pier, as above, a Perſon, who pretended to be an Engineer, adviſed my Principals I was making an unſufficient Foundation, (tho' I had drove a Row of Piles cloſe to each other along the Front of the Pier, ſo that the Pier could not be undermined there by any Force of Water;) but when I had given my Reaſons, for ſaving ſo much Expence, the Majority of my Principals were on my Side, and the Work went forward.

I have inſerted this Account, with an Intent to to perſuade whom it concerns, not to truſt to any one who pretends to be an Engineer, but make a ſtrict Enquiry into his Character as an Engineer, eſpecially in Places where he has been employed; and as moſt Men have two Characters, do not believe the firſt Account of him till you have had ſeveral Accounts: And as there are ſome who thro' Favour jump into a Character, if there are ſeveral Engineers of good Character, chuſe him who has had the greateſt and longeſt Practice; for there are but few Men who are capable to judge of an Engineer's Abilities, and conſequently but few who can give a true Character of him.

If a Pier is to be built where the Bottom is Rock, and the Rocks very uneven at the Top, and the Depth of the Water from three Feet deep to twenty; the high Tops of the Rocks may be lowered by Drills, as mentioned in *Page* 150 (where the Foundations of Bridge-Piers treated of;) but it will be

be impracticable, as well as unneceſſary, to make the whole Bottom level by Drills, or otherways; for the Bottom, where every ſingle Piece of Maſonry is to be placed, need only to be made level ſingly one after another; for which Purpoſe they muſt be founded, and the Platform of Timber made to fit the Bottom of each as near as poſſible, which is the more practicable as every Piece of Maſonry covers only about three Feet of Foundation lengthways; ſo that one Piece of Maſonry may ſtand upon a high Place, and the next let down to a lower Place, if it ſo happen: The greateſt Difficulty is to make the Pieces of Maſonry find a proper Seat in the Croſsway in the Pier, from the Front inward; but the Pieces of Maſonry being a conſiderable Length croſs-ways, the Bottom may be founded, and the higheſt Places lowered by a Drill or otherwiſe; and a Body of Timber prepared and ſunk under the Maſonry, that will make a Bed level enough for the Maſonry to lye upon.

If a Pier muſt be built in eight or ten Feet Water, and Stones can be had any Length to twelve or thirteen Feet; I would as before, ſee *Page* 156, make a proper Slope, and ſlip the Stones down to the Bottom one upon another, not too upright, nor too much reclining, but lying a ſufficient Weight upon the Stones undermoſt; (if Stones cannot be had of one Length to reach the Bottom, two may be cramped together to anſwer the Purpoſe) with a Groove on the upper Bed of each Stone, to receive Toggals let into the under Bed of each ſucceeding Stone; ſo that the Toggals will ſlide down the Grooves, and keep each Stone faſt in its Poſition; the upper Ends to be made to lye well back from the Front, that the Materials put into the Middle of the Pier do not force them forward. Upon the upper Ends of theſe Stones muſt be laid ſtrong binding Courſes a-croſs the Pier, to

keep

keep the Pier together; and a Row of Dove-tail Piles muſt be driven on each Side the Foundation, to keep the Sea from undermining the Pier.

When Stones cannot be had without too great Expence, make Bricks 15 Inches long, $7\frac{1}{2}$ Inches broad, and $2\frac{1}{2}$ thick when burned; put two, $2\frac{1}{2}$, three or more of theſe Bricks together, with the ſtrongeſt Mortar, and let them be thoroughly dried before you uſe them; with theſe Bodies of Bricks, make Pieces of Maſonry, and ſink them as directed before in ſinking Stone Piers, or Pieces of Maſonry, *Page* 159, But a Difficulty will ariſe in lowering the Brick Piers the upper Part of the Side next the Slope it ſlides down againſt, will lift up by the Friction more than large Stones, To prevent this, put two hard Oak Boards againſt the Slope; one near the Forepart, and one near the Back Part to ſlide down with the Pier; the Space between theſe Brick Piers occaſioned by the Oak Boards, to be filled up by the running Terras-mortar and ſmall Stones into it: If Worms deſtroy the Boards, the Terras-Mortar will keep the Work firm.

It might prove very uſeful to young Practitioners, if the minute Actions, in the Execution of Schemes for Foundations, &c. were explained: For the executing ſuch Schemes are the moſt difficult Part; it being eaſy to ſay do this, or do that; and the ſcheming Theoriſt would generally make a poor Figure, were his Plans to be executed in all its material and minute Parts by his particular Orders. But, to explain all the minute Actions neceſſary in the practical Part, exceeds my preſent Deſign; I not having time to ſpare for ſuch a Work.

CHAP. VI.

Of the Length of Arch-Stone.

AS there are no Rules, I know of, that determine the Length of Arch-Stones, proportional to the different Spans or Widths of Arches, I will give the Reader what I have gathered from Practice and Obſervation upon this Head; but it may be proper, firſt, to give an Account of what M. *Belidor*, an eminent *French* Engineer, and M. *Gautier*, have ſaid on this Subject, as collected by M. *Mullar*, who ſays in his *Practical Fortification*, *Page* 253, as follows:

" The Thickneſs of Arch-Stones, I muſt confeſs, " is not to be determined by Theory, at leaſt that " I know of; nor do thoſe Authors who have written " on the Subject agree among themſelves. M. " *Gautier*, an experienced Engineer, in his Works, " makes the length of the Arch-Stones, of an " Arch 24 Feet wide, 2 Feet; of an Arch 45, 60, " 75, 90 wide, to be 3, 4, 5, 6 Feet long reſpectively; when they are hard and durable, and " ſomething longer when they are of a ſoft Nature. " On the contrary, M. *Belidor* ſays they ought to " be always one Twenty-fourth Part of the Width " of the Arch, whether the Stone be hard or ſoft; " becauſe, if they are ſoft, they weigh not ſo much.

" But that the Length of the Arch-Stones ſhould " be but a Foot in an Arch of 24 Feet wide, 2, 3, " 4, in Arches of 48, 72, 96 Feet, it appears to be " impoſſible; becauſe the great Weight of the " Arches would, as I imagine, cruſh them to Pieces, by the Preſſure againſt one another; and " therefore M. *Gautier*'s Rule ſeems to be much " preferable: As he made the Length of the Arch

" Stone

" Stone to encreaſe in a ſlower Proportion, from 10 " to 45 Feet wide, than in thoſe above that Width, " whether they are great or little: Therefore in the " following Computation, we ſhall ſuppoſe the " Length of the Arch Stones of 30 Feet in width " to be two Feet, and to increaſe one Foot in fifteen, " that is 3 Feet in an Arch of 45 Feet, 4, 5, 6 in " an Arch of 60, 75, and 90 Feet; and ſo the reſt " in the ſame Proportion."

The moſt uſeful Knowledge, in any Action where Expences are required, is, to know how to bring the Affair to a good Concluſion with the leaſt Expence; and he is the beſt Artiſt in Building that is capable of erecting a Houſe, Fort, Bridge, &c. that will anſwer the End for which it is built, without any unneceſſary Expence; but ſuch a Man muſt not only have a good Genius, but be alſo a thorough Practitioner both in Practice and Theory: There are few ſuch Men compared to the great Number that know only a little of each, and yet are often intruſted with Works of the greateſt Conſequence; ſo that it is more than twenty to one againſt your happening to get a Perſon that can execute a Work with the leaſt Expence, to anſwer the End propoſed.

I have obſerved the different Extremes, and Expence miſapplied in many Places; and it will generally be ſo till Men of Fortune and Intereſt take the Trouble to qualify themſelves to diſcover and encourage Men of proper Talents.

It appears to me the length of Arch-Stones depends on too many Circumſtances to fix any certain Rule to go by; for, a half Circle Arch doth not require ſo great a Length of Arch-Stone, as a Segment Arch of equal Span or Width; and the flatter Arches are, the longer Arch-Stones they require in Proportion to their Width; and the great Difference in the Quality of Stone and Mortar, may induce a

good Judge to make the Arch Stones a little ſhorter, or longer; and if an Arch has more riſe or pitch than half its width, as ſome Gothich Arches have, ſuch Arches or Openings may be made with Spanderals, without Arch Stones, ſee *Fig.* 2. in *Plate* IX. which would ſave the Expence of the Center.

I made an Arch in *Sunderland* Pier, of 40 Feet 8 Inches wide between the Springers. The Archſtones are, in general, only one Foot three Inches long; but, the Arch Stones that make the Face of the Arch or Pier, are irregular Lengths; the ſhorteſt is one Foot eleven Inches long. This Arch is built chiefly without Mortar, and Works are not yet built, as intended, to keep the Sea from beating againſt it; and yet there is no Danger of the Arch falling: Indeed there is no heavy Carriages goes over this Arch.

There is a Bridge (of two Segment Circle Arches) over the River *Wear*, at *Biſhop-Auckland*, in the County of *Durham*, whoſe North Arch is 100 Feet 5 Inches wide, its riſe 22 Feet: Here is three Arches laid one upon another; but the uppermoſt appears a very bad Arch, being irregular Stones, as if built only to help to ſupport the Battlement; the firſt and undermoſt Arch is 14 Feet 6 Inches broad; the 2d Arch lies over the Arch under it near 3 Inches on each Side; the third and uppermoſt Arch ſets over the ſecond Arch in like Manner; and the Battlement alſo ſets over about three Inches; thus about eight or nine Inches breadth on each ſide is gained, to make more Room for Paſſage on the Bridge. The Length of the Arch Stones of this Arch (of 100 Feet, 5 Inches wide) is no more than two Feet, and the Stones of the Firſt Arch doth not appear to have hold of, or even Connection with the ſecond Arch, which is turned cloſe upon it; but as the Stones of the firſt Arch appears longeſt at the Crown, or Middle of that Arch, and as there appears a conſider-

able

able wide Joint of Mortar, between the Crown of the firſt Arch, and the underſide of the ſecond or Counter Arch over it, I am induced to believe the Crown of the lower Arch has come down an Inch or more from the Arch above it; and that low Arch hangs by its Abutments clear and independant of the Arch above it, (tho' the Arch Stones are only two Feet long, and the Arch 100 Feet 5 Inches wide, and riſes but 22 Feet, as I ſaid before;) which with the bad irregular Arch over that again, ſupports the Superſtructure, and the Weight of Carriages that go along the Bridge.

The South Arch is 91 Feet 5 Inches wide, and 20 Feet Riſe or Pitch, with 3 Arches one over another, in every Reſpect as the North Arch, ſave that the Arch Stones is only one Foot ten Inches long. I meaſured the Length of theſe Arch Stones, but the Length of the North Arch Stones was given me, and as I could not diſcern (tho' I ſtood very near) the North Arch-ſtones, to be longer than the South Arch Stones, I am ſatisfied the Meaſure is right; the Crown of this lower Arch, has alſo dropped from thoſe above it, about an Inch, and hangs independantly between its Abutments; the ſecond, or counter Arch, aſſiſted by the third Arch, bears the Superſtructure. This third Arch appears a much better Arch than the North third Arch; the Arch Stones in all the three Arches are near of a Length.

The Pier between the Arches is 19 Feet 5 Inches thick, and built in the uſual Manner; the upper Part of this Bridge is of very irregular bad Stones, the whole Breadth on the Top Battlements included, is no more than 15 Feet 10 Inches.

This Bridge was built by *Wilfre* or *Wilfred Shirley* in 1338.

I could mention other Bridges, whoſe Arches appeared to me ſo very ſlender, that I would not, 20 Years

Years ago, ventured along them, if I had not known Carriages, &c. had gone over before me; and I believe there are very few Inſtances of Arches failing, but there was ſome other Defect than the Arch Stones being too ſhort; and with Reſpect to M. *Belidor*'s and M. *Gautier*'s Rules for determining the Length of Arch-Stones, I cannot help thinking that better Rules may be found, for, M. *e lidor*'s Rules for the Length of Arch Stones, is one twenty fourth of the Width of the Arch, but by this Rule, the Arch Stones in ſmall Arches, *i. e.* from ten Feet wide to thirty, would be too ſhort to bear heavy Carriages; for the Arch Stones in an Arch of wte Feet wide, would only be five Inches; and ntenty Feet wide ten Inches; and in an Arch of thirty Feet wide fifteen Inches, &c. But from forty Feet width to eighty five, M. *Belidor*'s Rule will do indifferently well; and from eighty five upwards, one Twenty fourth Part of the Width of the Arch makes the Arch Stones too long. See the following Table.

A TABLE ſhewing the Length of Arch Stones for Circular Arches to bear heavy Carriages, from 10 Feet width to 120.

Width of the Arch in Feet.	Part of the Width of the Arch.	Length of the Arch Stones in Feet and Inches. F.	I.
10	$\frac{1}{10}$ or	1	0
15	$\frac{1}{12}$ or	1	3
20	$\frac{1}{14}$ or	1	5
25	$\frac{1}{16}$ or	1	9
30	$\frac{1}{17}$ or	1	9
35	$\frac{1}{18}$ or	1	11
40	$\frac{1}{19}$ or	2	1
45	$\frac{1}{20}$ or	2	3
50	$\frac{1}{20}$ or	2	5
55	$\frac{1}{21}$ or	2	7
60	$\frac{1}{22}$ or	2	9
65	$\frac{1}{22}$ or	2	11
70	$\frac{1}{23}$ or	3	1
75	$\frac{1}{23}$ or	3	3
80	$\frac{1}{23}$ or	3	5
85	$\frac{1}{24}$ or	3	6
90	$\frac{1}{25}$ or	3	7
95	$\frac{1}{25}$ or	3	8
100	$\frac{1}{27}$ or	3	9
105	— — —	3	10
110	— — —	3	11
115	— — —	4	0
120	— — —	4	1

Theſe Arch Stones are of a ſufficient Length, eſpecially where there is good Mortar and good flat rough Stones to form a Counter Arch, to keep the Shaking of heavy Carriages from the Arch below, and as a good Thickneſs of Mortar and rough Stones, are, or ought to be, generally laid upon the

the Crown of every Arch. It may be ordered ſo that the rough Maſonry upon the Arch ſhall, when dry, form almoſt as ſtrong an Arch, as that below it, and the Difference of Labour in building the rough Maſonry archways, is ſcarce worth mentioning.

As to M. *Gautier's* Rule, it makes the Arch-Stones much too long, as is plainly demonſtrated by all the Arches I have ſeen, and in particular by the Bridge at *Biſhop-Auckland*, in the County of *Durham*, above mentioned, the Arch Stones in the Arch thereof 91 Feet 5 Inches wide, is no more than one Foot ten Inches long, which by M. *Gautier's* Rule ſhould be ſix Feet long, beſides the Expence ſuch an Arch will coſt, it will require a large Quantity of Timber to make a Center to ſupport ſo great a Weight, ſuch an Arch as this will be very expenſive without a Neceſſity; for if the Length of the Arch Stones are only ſufficient to ſupport its own Weight, and a Quarter more, by building upon this Arch in the Manner above mentioned, will make the Bridge ſufficiently ſtrong to anſwer the End.

CHAP VII.

THE Art of making Rivers, Creeks, Harbours, &c. more ſafe and commodious for receiving Ships and other Veſſels, and the making the beſt Uſe of the Fluxes of the Sea towards making Rivers navigable, as far up within the Land as poſſible, and to get a ſtrong Reflux to keep Rivers Mouths clear of Obſtruction, is an Art of conſiderable Conſequence in many Places of *Europe*, eſpecially in ſome Places of *Britain*; therefore I will endeavour to clear up a Point or two; the acting upon the wrong Side of which, has been very injurious to the Navigation of many Rivers and Harbours

bours, and the Cauſe of ſeveral uſeful Harbours being entirely loſt.

The firſt Point in Queſtion I ſhall examine, is, whether large Receivers in Rivers a Mile or two or more or leſs up the River from the Sea, (ſuch as *Jarrows* Lake in the River *Tyne*,) doth, or doth not cauſe the Flux of Water to come into Rivers with greater Force than if the Rivers were nearly of a Breadth, from the Sea to the End of the Flux. In order to ſet this Point in as fair a Light as I can, I will imagine two Rivers of equal Breadth and Depth, from the Sea for a Mile up within the Land, ſo that the Entrance of each River will admit an equal Quantity of Water, and each River has the ſame Turnings, and upon a Level ten or twelve Miles up; but one of them is no wider than at its Entrance all the Way up to the End of the Flux; and the other River from about a Mile from the Sea, is very broad, and continues broad for a Mile or two further upward, and then narrows to near the ſame Breadth of the other River; and the Flux of the Sea riſing to the ſame Height at the Mouth of each River, I think I may venture to ſay, it is natural to conclude that more Water will go into the River that has the greateſt Receiver; and the Stream will run into and out of that River with greater Swiftneſs and greater Force, than it will run into and out of the River that hath the ſmall Receiver.

Tho' I think the Concluſion I juſt now made is ſelf-evident, but, by way of Illuſtration, give me Leave to ſuppoſe two Tubes of equal Dimenſions, (each three Inches broad, and eighteen Inches high) placed for Water to run through them, to fill two Spaces each eighteen Inches deep, which is the Height of the Tubes or Openings, and one hundred Feet long, more or leſs; but one Space or Receiver to be three Times as broad as the other, and conſequently

ſequently will hold three times as much Water. Having Things properly fixed, make a Body of Water, like the Flowing of the Sea, come gradually againſt and run through theſe Openings, to fill the Spaces or Receivers (mentioned above;) and I make no Doubt (when the Spaces or Receivers is about ¾ full) but there will be a perceptable Difference between the Streams in the two Receivers, flowing at the further Ends above the Level of the Openings where the Water comes in, or what we may call the Sea: And the Stream in the large Receiver, or larger River, will when the Receiver or River is ¾ full, riſe more above the Level in the Receiver at the further End, than the Stream in the ſmall River or Receiver. This is the ſecond Point to be proved; and if the Water is raiſed gradually (like the flowing of the Sea) to the Tops of the Openings, both Receivers or Rivers will be filled to the ſame Height, by the ſame Flow of Water without; tho' one holds three Times as much Water as the other, conſequently the Water muſt run with three Times the Velocity in at the Openings that is to fill the great Receiver, or River, than it doth in at the Opening that fills the ſmall Receiver or River; and if you let the Water come out again at theſe Openings, by making the Water without receed, like the Ebbing of the Sea, it will run out at the Opening in the large Receiver or River, with much more Force than from the Opening to the ſmall Receiver; and is the third Point to be proved, which I think muſt appear evident to every one that knows any Thing of the Nature of Fluids.

The Reaſon of large Receivers, or large Rivers, being filled to the ſame Height, that ſmall Rivers or Receivers is filled to with the Flux of the Sea, through Openings or Inlets of equal Dimenſions, are, The ſmall Receivers or Rivers, fill faſter than the large Receivers or Rivers, till near high Water without;

without; by which the Velocity of the Water, thro' the Inlet to the ſmall Receivers, is retarded that it cannot run into the ſmall Rivers or Receivers, ſo faſt as into the great Rivers or Receivers; and the Sea when flowed to its Height, keeps up at its Height a ſufficient Time for large Receivers to take in much Water after the ſmall Receivers or Rivers are full, conſequently the Streams doth run with a conſiderable Force a conſiderable time into the large Receivers, after it has done running, or runs but very ſlowly, into the ſmall ones.

The Reader, I imagine, is now of Opinion that the Tides run with greater Velocity into thoſe Rivers that have large Receivers, than into the Rivers that have ſmall Receivers. The Entrance being of equal Depth and Breadth, and conſequently the enlargeing or leſſening the Receptacle for Water in a River, augments or diminiſhes the Force of the Stream into that River. This Maxim in Hydraulics, I think, is clear and well founded: This is the firſt Point I propoſed to examine; and have in few Words ſet it in as fair a Light as I can.

It now being evident, and I ſuppoſe acknowledged, that the larger a Receiver is in a River, the Stream will come into that River with a proportional greater Force. This being admitted, it cannot be denied, that,

The large Receivers in Rivers, are alſo the Cauſe of the Stream running farther up the River than it would do if the Receivers are much leſſened, or quite filled up. This is plainly proved, by the Tides not running ſo far up the Rivers, after the Receivers have been leſſened, as has been atteſted by ſeveral who have taken Notice of theſe Matters: An an old Man, of good Credit, ſaid he learned at a School near the River *Tyne*, and he, when a Boy, often ſaw the Tide cover a particular large Stone

that

that lay in the River, near where they uſed to play; but now the Tide doth not flow up ſo far by about a Mile and an Half. And a Gentleman who lives upon the River *Wear*, in the Neighbourhood of *New-Bridge*, affirmed in my Hearing, that he, when a Boy, ſaw Straw driven upward through *New-Bridge*, with the Tide; and now the Tide doth not flow ſo high at *New-Bridge* by about two Feet perpendicular; and I know the Receiver of the River *Wear* has been much leſſened, and many Keys built in the River ſince that time. Here it may be replied, The Sea may, in ſixty Years, have receeded from the Shore ſo much where the *Tyne* and *Wear* are, as to cauſe the Difference of the Tides up theſe Rivers here mentioned. I know the Sea has receeded from Shores which I have ſeen; but as I never heard that any Perſon has taken Notice of any ſuch Difference of the Tide in *Shields* or *Sunderland* Harbour; and there being no Token nor viſible Marks to be ſeen at either Place, whereon to ground the leaſt Suſpicion of ſuch Difference of Tides in theſe Harbours, it may be ſaid without Fear of Contradiction (that is founded in reaſon) that the Tides now not flowing ſo high up the *Tyne* and *Wear*, is entirely owing to building Keys, and leſſening the Receptacles in theſe Rivers. This is the ſecond Point I propoſed to examine; and it is evident that the Water runs fartheſt up the Sand, on the Sea Shore, and in greater Quantities when the Waves puſh it with the greateſt Force; and it is alſo evident a Ball will run fartheſt up a Hill, and return back with the greateſt Force, when thrown up a Hill with the greateſt Velocity: So will the Water run ſtrongeſt into, and out of thoſe Rivers that have the largeſt Receivers. This is the ſecond and third Points with reſpect to the Utility of large Receivers in Rivers, propoſed to be examined. Theſe foregoing Maxims being

being clear and evident, it muſt be highly criminal to fill up the Receivers in a River, or Stop the Tide from flowing up a River, by Building Dams, &c. eſpecially in Rivers where the Tide did not, before ſuch Encroachments, flow far enough up for the Trade carried on in that River, nor the Reflux ſufficiently ſtrong, before ſuch Encroachments was made, to keep the River's Mouth effectually open, for Ships to ſail out and into the Harbour. I think more need not to be ſaid to prove that the filling up the Receivers in Rivers, both ſtops the Stream of the Tide from getting ſo far up inland as to enable ſmall Craft to Trade better up and down the River; and alſo deprives the River of its antient neceſſary Stock of back Water, which is abſolutely requiſite, and was not anciently quite ſufficient, and muſt be leſs ſufficient to keep the River's Mouth ſufficiently open, when much of the antient Receiver is filled up.

So little has the Art of improving navigable Rivers, Harbours, &c. been attended to or underſtood by my Countrymen, that in the latter Part of *March*, or Beginning of *April*. in 1759, an *Engliſh* Engineer, (looked upon by Gentlemen as a very ingenious underſtanding Engineer) aſſerted before a Number of Gentlemen (the Place and Gentlemen's Names I could mention,) That if a Dam was made acroſs the River *Wear*, to ſtop the Tide at the Low Key (which is only about a Quarter of a Mile from the Sea) it would in no Shape injure the Port.

To underſtand how far the above Aſſertion proves the Gentleman that made it an ingenious underſtanding Man, in the Affairs of improving navigable Rivers, Harbours, &c. the Reader muſt be acquainted that the freſh or land Stream, that comes down the River *Wear* in Summer, is little more

than

than ſufficient to make two Mills work. Great Land Floods generally happen only once in 3, 4, or 5 Years; and there are many Thouſands of Tuns of Sand and Gravel caſt into the Sea every Summer, within about three Quarters of a Mile off from *Sunderland-Bar*; a great Part of which the Sea throws a-Shore upon, and near to, the Entrance of the River *Wear*, and Port of *Sunderland*; ſo that the preſent Reflux (though the Spring Tides flow near Twelve Miles up the River) is barely ſufficient to drive the Sand away, and maintain an indifferent Entrance; but if the Tide was ſtopped, (by a Dam as above) from coming up the River but for three Months, the Sand and Gravel would be thrown by the Sea, as high upon *Sunderland Bar*, as any other Parts of the Shore, ſave a very ſmall Shallow Gut made by the upland freſh Stream, which would not receive a loaden Keel (much leſs a Ship) to ſail into or out of *Sunderland* Harbour, except for about two Hours on the Top of Spring Tides. For,

It is evident the Flux and Reflux of the Sea, near the Land, make but a very weak Current direc. ly toward the Land, or directly off to Sea, ſave where there is a conſiderable Receiver within the Land, like *Portſmouth* Harbour, *Southampton* River, &c. and the greater the Indraft, the greater Diſtance from the Shore doth it begin at. And if a Dam is made a-croſs a River Six Miles up from the Sea, and ſtop the Indraft or Tide there, which uſually flowed 10 or 12 Miles up the River; by this Dam the End of the Flux Stream would be only ſix miles from the Sea, inſtead of twelve; conſequently ſix Miles length of Stream will not only be loſt to the Navigation, but the Indraft or Inſett and Outſet will be will be much weakened, ſo that Veſſels will loſe the great Advantage of a ſtrong Inſett to carry them into the Harbour againſt ſtrong off-Shore Winds,

which

which is a material Point, and being wanting, renders the Entrance leſs navigable; and many Ships will be obliged to keep the Sea, which would have got the Harbour if the Dam had not ſtopt the Tide, and weaken'd the Inſett; to ſay more on this Head, would be ſuperfluous, I having in the foregoing Pages prov'd that the leſſening the Receivers of Rivers is greatly injurious, and may quite ruin the Navigation and Trade of a River, and totally ſtop the Tide with Dams from going up ſuch Rivers, as the *Wear*; is ruining the Navigation to all Intents and Purpoſes at once; if Power had been obtained and a Lock made at *Biddock-Ford*, or Mr. *Lambtons high Staith*, or at either Place, the Navigation of the River *Wear*, and Port of *Sunderland*, would have been greatly injured, and the Public Loſs would have been greater by ſtopping the Tide at *Biddock Ford*, than the greateſt Advantage that could be hoped for, from the upper Navigation would make amends for; for great Tides fills the River two Miles and a half above *Biddoc Ford*, and two Miles above Mr. *Lambton's high Staith*, which part of the River holds a very uſeful Stock of back Water; without which, the Trade could not be carried ſo well on at the *Staiths*, nor could the latter part of the Tide run to Sea with a ſufficient Force, to maintain ſo good a Channel to Sea, as is now, &c. all which put together (in my Opinion) would injure the Public more than ten thouſand Pounds a Year; for the Value of a Foot depth of Water, loſt or gained in the Entrance of the Port of *Sunderland*, is more than four thouſand Pounds a Year loſt or gained to the Public, as is clearly proved by an Eſtimate lately made, this being a Digreſſion, I have not inſerted the Eſtimate abovementioned.

It may be proper in this Place, to obviate an Argument that has been made uſe of, to ſupport an Opinion that large Receivers in navigable Rivers, Ports and Havens, are of no Conſequence with regard to keeping the Entrances clear of Obſtructions, &c. For ſay ſuch ſuperficial Reaſoners, If the Outſet is ſtrong, the Inſet is alſo ſtrong, and brings Matter into the River to make Obſtructions, in a Degree equal to the Strength of the Outſet: Therefore the Strength of the Out and Inſet of the Tide, is not of ſuch Value as is imagined; nor are large Receivers of any Conſequence in maintaining a good Channel to Sea. Such Reaſoners and ſuch Reaſons as to themſelves doth not deſerve an Anſwer; but as they ſometimes do much Miſchief, I will ſhow the Fallability of this Manner of arguing.

Navigable Rivers generally have a conſiderable Stream of freſh Water, which runs from the Land, and impedes the Inſet from the Sea, proportionally to the Quantity and Velocity of the freſh Water Stream in that River; but when the Flux of the Sea receeds, and the Stream of the River returns back again towards the Sea, it meets no Hindrance from the Counter-Stream; but the Outſet increaſes in Force, as the Surface of the Sea lowers, and the Water that has been depoſited by the Flux of the Sea far up the River, returns toward the Sea along with the natural Stream of the River, when the Sea has receeded ſo far as to give no Obſtruction to the Outſet; but that the whole Weight of the Stream ſcowers the Bottom of the Channel or Bed of the River, and in many Rivers augments the Force of the Outſet, to double the Force of the Inſet; not to mention the Advantage the Outſet has, by the Deſcent the River's Bed has towards the Sea: And to prove that this is clearly agreeable to the Nature of Things, I muſt acquaint the Reader that more

Water

Water goes out with the Reflux, than comes in with the Flux; for all the time the Flux of the Sea repels the freſh Stream, the freſh Stream is filling the River jointly with the Flux of the Sea; and what ever Quantity of Water came down the River in the time of the Flowing of the Sea, ſo much greater Quantity goes out with the Reflux, than comes in with the Flux. This is one Reaſon why the Stream of the Tide runs ſtronger out of than into Rivers. There is another Reaſon why a ſtrong Inſet doth not carry much Sand and Gravel into a River, and is this, The greateſt Force where the Stream is not obſtructed (but can run ſtrait) is near the Middle of the River, and this Force gradually diminiſhes toward the Shore, where is little or no Stream; ſo that what Sand, Gravel, &c. is raiſed by the Stream, it ſubſides towards the Shores, and in Eddies of Points, &c. till the Reflux remove it downwards toward the Sea; and the Reflux being ſtronger than the Flux, it forces the Sand, Gravel, &c. further downwards than the Flux can carry it upward: This is the principal Reaſon why Rivers keep ſo well open where much Ballaſt is caſt.

We are not without Inſtances of there being very good Harbours, that have little or no Land Water to aſſiſt the Reflux in keeping the Entrances open; and yet the Entrances are ſufficiently deep for the largeſt Ship of War to ſail into or out of ſuch Harbours, but then the Receiver within is very large: *Portſmouth* Harbour is an Inſtance and Proof of this; it receives very little Land Water, and is a good Harbour for our largeſt Ships of War, notwithſtanding the large Sands that lye before that Harbour's Mouth. I think this cannot be accounted for any better Way, than the Reflux is not impeded ſo much in its Courſe to Sea, as the Flux is in running into the Harbour; therefore the Re-

flux runs out of the Harbour with a Force ſufficient to keep the Entrance clear of Sands, Gravel, &c. *Portſmouth* Harbour plainly proves that a large Receiver will maintain a good Harbour, without the Aſſiſtance of Land Water: This appears to me another plain Proof of the Uſefulneſs of large Receivers in Ports, Havens and navigable Rivers; and that the leſſening Receivers in Ports, Havens and navigable Rivers, are injurious to Navigation.

Before I leave this uſeful Subject, I will endeavour to ſhow the Reaſons why much Expence has been beſtowed to little Purpoſe, in deepening ſhallow Places in Rivers. I am the more induced to this by a Relation from a Perſon who was a principal Director in attempting to deepen a Shallow Part of a River in *Yorkſhire*. He ſaid a Body of Gentlemen of *York*, expended above £10,000 in this Attempt, and was at laſt obliged to make a Lock, to make that Part of the River navigable.

In attempting the deepening a ſhallow Part of a River, the firſt Thing proper to be known is, whether the Bed of the River above this ſhallow Place, is low enough to have a ſufficient Depth of Water upon it for the Navigation, when the ſhallow Place is deepened; for where there is a Stream or ſharpe in a River the Surface of the Water below that Stream is lower than the Surface of the Water above it; and when the Bed of the Stream is lower'd to the Level of the Bed of the River above it, the Water's Surface upward will become lower than it was before, conſequently ſhallower. If the Water is ſufficiently deep upward, a ſhallow Part below may be deepened to anſwer the Purpoſe, by employing as many Men as will in all Probability effectually remove the Obſtruction before any Flood can bring freſh Matter there; I mean as many Men ſhould be employed in a proper Seaſon, as can do any Service; for no Man

can

can know how long it may be before a Flood happens; and that heavy Matter will generally reſt where the River is ſhalloweſt, is plain and evident from common Obſervation, and from the Nature of the Actions of Fluids. For,

Fluids preſs and ſcower the Beds of Rivers with a Force proportional to the depth or perpendicular Height of the Stream, and not according to the Swiftneſs and Breadth of the Superfices. If this is not the Caſe, how can we account for the deep Places of Rivers not filling up; for there the Water appears to have and has a very gentle Motion; but on the contrary, heavy Matter drops and lodges in the ſhallow Places where the Water runs ſwifter: This is ſelf evident; and to give more Reaſons than above why it is ſo, will be both miſpending my time and the Reader's. Having firſt given the above Account, I think it proper to give the following Caution and Advice.

As I ſaid before, remove the Obſtruction with all Speed; for if you have proceeded and deepened a ſhallow Place a third, or a half of what it muſt be deepened, and if a Flood happen, it is very probable the Flood will leave near as much heavy Matter on the ſhallow Part, as you have taken away; and you may be ſerved ſo many times until the Expence become unſupportable; but if you have the good Fortune to get the ſhallow Part all deepened equal to the River above and below, before a Flood come, every Part then will have an equal Force of Scowering; and in many Caſes no Man can be aſſured where the next Obſtruction will gather, or whether any will gather at all.

APPENDIX.

Of manning the Britiſh Navy with leſs Grievance to the Subject.

THIS great Object, I may venture to ſay, hath long taken up the Attention of ſeveral able and judicious Gentlemen, from whom different intereſting Schemes and Plans have been produced; one of which, in a late Seſſions of Parliament, made a conſiderable Progreſs. But as Affairs of ſuch high Importance carry with them their bad as well as good Effects, the above named Plan, after paſſing the Examination of the honourable Houſe of Commons, two or three times, was found to bear too hard upon the Liberties of the Subject, and therefore was not carried into a Law. But the Gentleman who was Parent of it, had the private Thanks of ſeveral of the Members, who urgently preſſed him to continue his good Offices towards the perfecting ſo deſirable a Scheme, which the whole Houſe ſeemed to have ſo much at Heart.

As this happened, ſince the firſt Advertiſement of the BRITISH MARS, to the Plan of ſo able a Gentleman, it cannot be expected any Productions of my Pen would deſerve Notice; and I was once almoſt determined to forbear touching on that Subject: But when I reflected on the almoſt Impoſſibility of any one Perſon being able to form a Plan of that Kind, clear of Objections; and that it is yet probable from many propoſed Schemes, a good one may be adopted. I have from a hearty Deſire to be uſeful to the Public, at laſt ventured to offer the following

lowing to their Conſideration; and ſhall endeavour in the firſt Place to give an Anſwer to the general Complaint, That Seamen are worſe treated than any other of his Majeſty's Subjects.

Iſt. As the preſent Manner of raiſing Seamen to man his Majeſty's Fleet, is well known to moſt People in the Nation; therefore Parents who bind their Children to the Sea Service, or others of adult Years who betake themſelves to that Employ, ſhould never complain whenever it falls to their Lot to be taken into his Majeſty's Service, becauſe they knew beforehand they were by the Cuſtom of their Employ ſubject to it: And it is on that Account the Wages of Seamen in the Merchant's Service even in Time of Peace, are much higher than other labouring Peoples, and in time of War are carried to great Extravagancies; therefore if the Expectation of ſuch Gain draw them to Sea, they voluntarily bring upon themſelves the Hardſhips complained of; and the trading Part of the Nation, who pay ſuch extravagant Wages, have a Right to their Service in the Navy, according to Cuſtom preſcriptively eſtabliſhed.

IId. If there is any Injuſtice in the Caſe, it can only be in this, That Seamen are not taken in their Turns to ſerve in the Navy, and this fall chiefly among themſelves, becauſe of the great Difference between the Pay of the Navy and the Merchants-Service: Each one ſtriving as much as poſſible to avoid the firſt, and obtain the latter. Now to bring the Wages in the two Services to near an Equality, will be bringing the Matter nearer to Juſtice; and to which Purpoſe, the following Scheme, which if it could be brought about, would be a great Means to man the Navy with leſs Grievance to the Subjects. Tho' all poſſible Care has been taken by the different Acts of Parliament for the Encouragement

ment of Seamen to enter into his Majeſty's Service, yet the great Difference of the Pay of Merchant Ships in time of War, from 3 or 4*l.* per Month to that of the Navy, being only 22*s.* per Month, makes them very backward to enter, and even when on board to perform their Duty with great Reluctance. Now I would humbly propoſe that a Tax be laid upon every Seaman in the Merchant Service in time of War only, at ſo much per Month, as will be a Mean between the Pay in the Navy and the Merchantmen. This may be done by getting the Knowledge of the Wages paid by the Merchants in time of this and the two laſt Wars; and whatever the general Wages appear to have been more than the Pay in the Navy, the half of it ſhould be the Tax laid on theſe in the Merchant Service, to raiſe a Fund for the Increaſe of theſe Seaman's Pay which ſerve in the Navy.

Suppoſe the Difference be 30*s.* only the half 15*s.* for the Tax to be paid by the Seamen in the Merchants Service, and carried to the general Fund; out of which ſhould be paid 5, 6, 8 or 10*s.* per Month, as it would raiſe to every able Seaman in the Navy, and in Proportion to the rated ordinary, the Maſters, Commanders, Apprentices, not liable to be impreſſed, excepted from paying any Tax, for the better Encouragement of raiſing Seamen by Indenture for three Years. For Example, Suppoſe fifteen Thouſand Seamen liable to be impreſſed in conſtant Pay in the Merchant Service, and home Trade, their Tax at 15*s.* per Month, would raiſe 11250*l.* per Month, the yearly Amount will be 135,000*l.* which would give to 45,000 Men, employed in the Navy, 5*s.* a Calendar Month, over and above their common Wages. And if 8*s.* a Month, more or leſs, according to the Seaman's Will, out of their common Pay were added to that Sum, and ſuppoſing

135. a Month remitted conſtantly every half Year, after the firſt ſix Months, to their Wives and Families, it ſurely would have a very good Effect, and bring Men more chearfully to ſerve in his Majeſty's Navy.

In Ships which ſail Coaſt-ways by the Voyage, as they are ſeldom above a Month one Voyage with another, the Seamen may be taxed by the Voyage; and it would not be a difficult Matter to collect the Sum, if the Maſters and Owners who pay the Seamen's Wages, are under ſevere Penalties for not paying into a proper Office, erected for that Purpoſe, the Sums becoming due for every ſuch Seaman on board his Ship, for the Voyage or Month, every time the Voyage is finiſhed and the Wages paid.

Something to this Purpoſe, joined with ſeveral good Propoſals, mentioned in Capt, *Blake's* Scheme for manning the Navy, cannot fail of producing the following good Effects, viz. Seamen when impreſſed will not think it ſo great a Grievance to ſerve, becauſe, in the firſt Place, their Pay will become nearer to Equality to thoſe in the Merchant Service who pay ſo much back of their great Wages, to make their's the better; beſides the Sum thus raiſed proceeding from the extravagant Wages in the Merchant's Service, will hardly effect other Individuals than the Tavern-keepers and Bawds of *Wapping*, and the principal Sea-Port Towns, who generally fleece the honeſt ſailors of the greateſt Part of their Wages, and leave them rotten Conſtitutions into the Bargain; add to theſe, the great Expence that may be ſaved by keeping a leſſer Number of Tenders for the preſſing Service, nor will ſo many Seamen be ſo cruelly confined in the Tender's Holds.

I don't pretend to ſay the above Scheme is free from Objections, no doubt, but ſeveral will be found

found in the eſtabliſhing of it, but the greateſt that occurs to me at preſent, will be, that Seamen knowing they have to pay ſuch a Tax, will not go to Sea without having ſo much more Wages in Proportion to the Tax, and ſo it will fall upon the Trade. To this I anſwer, if that was the Caſe, it would become a greater Grievance than that intended to be removed; but I look upon our trading Gentlemen in whoſe Hands the whole of that will depend, to be better Managers; for if Seamen could have what Wages they pleaſe, they may as well inſiſt on 10*l.* a Month, as three Pounds; and there would be no End to their Extortions. But as few of them cares to go to Sea whilſt their Money laſts, it will be greatly the Merchant's Intereſts to keep the Wages low, for by that Means they may be able to trade with a ſmaller Capital to ſupply their Correſpondents with cheaper Goods, and get their Ships the ſooner and eaſier to Market.

I do not pretend to be capable of repreſenting the Benefit of the above Scheme in all its Advantages. Its from a hearty Deſire to do good to my Country I have publiſhed theſe few Hints (the firſt of which I had from a neighbouring Gentleman, viz. that of the Tax) expecting no more from them than that ſomething may be gathered that may prove uſeful to an able Hand, towards the promoting any Scheme for manning the Royal Navy with leſs Grievance to the Subject.

CHAP.

CHAP. II.

WHEN we are bleſſed with a Peace, our Seamen will be too numerous to be all employed in the Trade *Britain* at preſent poſſeſſes: By thinking on this Matter, it appears to be the Duty of every *Briton* to publiſh any Plan he conceives carries a Probability of encreaſing our Trade, and employing more Seamen. Theſe Thoughts led me to re-conſider the Nature and Trade of *Hudſon's Bay*; and the twenty Thouſand Pounds allotted by Parliament, as Part of the Reward for diſcovering the Northweſt-Paſſage from *Hudſon's Bay* to the Pacific Ocean, and great South Sea; upon a thorough Recollection it appeared ſomething more conſiderable might be done in that Part of the World, for which Purpoſe I formed the following Plan:

In the firſt Place, an Application muſt be made to Parliament, for an Act to enable his Majeſty's Subjects to ſettle, and people Places in the Countries adjoining to *Hudſon's Bay*, in order to carry on a Fiſhery all round the Bay, and in every River, Inlet, Creek, or Bay, without being obſtructed by the *Hudſon's Bay* Company; giving proper Security not to interfere in the Fur-Trade.

Powers being obtained to people and cultivate any Part of the Countries adjoining *Hudſon's-Bay*, at a proper Diſtance from the Company's Factories, in order to carry on a Fiſhery. Places muſt be erected where Seamen may dwell, in a proper Part for Cultivation, near a navigable River, where Families when they could not fiſh, might find it worth their Trouble to cultivate the Land; firſt for Greens and Roots, and after for Corn: There being already Plenty of Graſs for Cattle, Horſes, Sheep, Goats, &c. which cannot fail to increaſe, and yield Profit

in

in the ſouthern Parts of the Bay, in about 51, or near the Latitude of *London*; Swine and Beaſts of all Sorts, has nearly as good a Chance there to be profitable as in *England* or *Scotland*.

The Rivers are clear of Ice ſooner, by near a Month or ſix Weeks, in the ſouthern than in the nothern Parts of the Bay, conſequently the fiſhing Seaſon begins ſooner there than to the Northward, by at leaſt a Month or five Weeks. This Advantage, among many others of the Situation, not only gives the Fiſhers time when all together to prove any new Invention for killing more Whale; but alſo gives the Fiſhers an Opportunity to get to the northerly fiſhing Places in good time.

The principal Colony of Fiſhers being fixed in a Part of the Country that is capable of producing every Neceſſary of Life, the Fiſhery may be eaſily extended to every River on the ſouthweſt Coaſt, and the Eaſt Main, where the *Eſkimaux* doth not frequent for Fear of the other Indians.

It may be proper to obſerve, that by keeping a Net or two, ſet at the Mouth of every River, where Men are employed to kill Whales, as many Salmon and other good Fiſh may be taken, and ſalted, as will be a conſiderable Part of their Winter Subſiſtance.

The Veſſel that is to collect the *Eſkimaux* Trade, ought, the firſt Year, to proceed round the Bay, as ſoon as the Ice is gone off Shore, ſo as a ſmall Veſſel can ſail between the Ice and the Shore. And at every Place where *Eſkimaux* frequent, and can be ſpoke to, give them ſome Line, a light Harpoon, or two, a Caſk, &c. and make them underſtand you as you can, by Signs, or otherways, that you will come next Year and trade for Whalebone, Oil, Sea-Horſe-Teeth, Seal-Skins, &c. This do at every Place where you find any *Eſkimaux*; but be ſure and

by

by all Means, remember my Advice on this Point, which is, not to truſt the *Eſkimaux* (let their Appearance be ever ſo friendly) when they have Reaſon to think themſelves too ſtrong for you; by many Accounts which I know to be true, joined to many other well atteſted Accounts, they are the moſt ſubtle, treacherous and cruel Savages in the known World; therefore it ſhould be long ere I would make any Settlements among them, but viſit them yearly, and encourage them to kill Whales, &c. by giving them in Trade good ſuitable Fiſhing Tackle, and other moſt uſeful Things, to enable them to encreaſe their Trade. By this, and ſuch like Treatment, they would in time become tractable Fiſhers, without any Danger from them; for if they were aſſured of our coming yearly, they will procure all the Trade they can, and yearly look out for our Ships, and come off in their Canoes, as they do in the Straits to the Company's Ships. See what I ſay of the Fiſheries, in my Account of *Hudſon's Bay*, *Page* 63, of which the following is an Abſtract:

" The *Eſkimaux*, who are the profeſſed Fiſhers, " uſed to inhabit the Country on the Eaſt Main, be- " tween the Straits and the Bottom of the Bay: " But they are ſince driven away to the Northward, " by the other Indians who are rendered much ſu- " perior to them, on Account of the Supply of " Arms and Ammunition, which they receive from " the Engliſh: So that a Tract of Land of more " than three Hundred Miles extent from North to " South, lies almoſt waſte, without Trade and " without Inhabitants. *Churchil* River was much " inhabited by the *Eſkimaux*, before we ſettled " there; the Point on which the Fort is built, being " called *Eſkimaux* Point: Upon digging for the Fort " many Traces were diſcovered of their abode here, " ſuch as the Pit in which they ſecured their Provi-

" ſions

" ſions, Pieces of Stone Pots, Spears, Arrows, &c.
" This Point they kept ſome time after they were
" driven from the adjacent Country, becauſe as it
" lies far into the open Sea, they could diſcover the
" diſtant Approaches of their Enemies, and repair
" in time to their Canoes, in the Management of
" which they are peculiarly dexterous: But they
" were at length forced to go farther northward to
" Cape *Eſkimaux* and *Whale-cove*; and are now to-
" tally diſpoſſeſſed of their Retreat, by our making
" a Settlement here, and drawing down the North-
" ern upland Indians to trade, whom alſo we have
" ſupplied with Arms. But as People do not eaſily
" loſe their charecteriſtic Virtues, that Art and In-
" duſtry for which the *Eſkimaux* are diſtinguiſhed,
" they ſtill retain, even in a State of Flight and
" Diſperſion; and thoſe that are ſcattered about the
" Straits, kill Whales, Sea Horſes, Seals, Bears,
" &c. not only for common Subſiſtance, but for
" Trade, which they are very eager to carry on with
" our Ships, as often as they go by in their Paſſage
" to the Bay.

" A Sloop is ſometimes ſent to *Whale-cove* for a
" few Days in a Seaſon, and ſometimes not ſent at
" all; the People, therefore, having no Dependance
" upon our coming to trade with them, take very
" little Care to provide a Supply larger than is neceſ-
" ſary for their own Subſiſtance.

" In thoſe Years in which the Sloop was not ſent
" to *Whale-cove*, viz. 1745, 1746, and 1747, all
" the Whale-Finns that the Company brought to
" *England*, was procured in the Straits; the firſt
" Year 303 Pounds; the ſecond 1314 Pounds, and
" the third 226 Pounds, in all 1843 Pounds, as
" appears from the Account of their public Sales.
" But in the ſeven preceeding Years, when the
" Sloop was ſent to *Whale-cove*, the Account of their

Sales

" Sales ſtands thus: 1738, Finn 20 Pounds; 1739
" Finn 518 Pounds; 1740, Finn 630 Pounds,
" Oil 123 Gallons; 1741, Finn 149 Pounds; 1742
" Finn 679 Pounds, Oil one Tun at 18*l.* 13*s.*
" 1743, Finn 496 Pounds, Oil and Blubber 5
" Tons, 234 Gallons at 14*l.* 8*s.* per Ton; 1744,
" Finns 302 Pounds, Oil and Blubber 3 Tons, 218
" Gallons at 10*l.* 11*s.* per Ton: ſo that upon an
" Average, the Trade in Finns thoſe Years in which
" the Sloop was ſent to *Whale-cove*, does not equal
" the Trade when the Sloop was not ſent; therefore
" the greater Part muſt have been procured in the
" Straits, which as I ſaid before, is done curſorily
" as the Ships paſs into the Bay. But if ſo much
" can be gained without any Efforts, what muſt the
" Produce be from a profeſſed Deſign, and vigo-
" rous Endeavour to bring thoſe Fiſheries to Per-
" fection?

" The previous Step to this, is the re-eſtabliſhment
" of the *Eſkimaux* in the quiet Poſſeſſion of their
" Properties and Lives; ſuffering them to extend at
" Pleaſure towards the Bottom of the Bay, where
" they would find a milder Climate and better Coun-
" try; which abounds with Wood and good Har-
" bours; and taking Care to inform the Indians
" upon the Eaſtern Main, that the *Eſkimaux* are
" deſirous to live at Peace with them; that they
" will not interfere in the Fur-Trade, and that
" they are Friends to the *Engliſh* and under their
" Protection, who, if Hoſtilities are continued,
" will ſupply them with Arms and Ammunition for
" their Defence: Which impartial Diſtribution of
" Kindneſs and good Offices would effectually diſſi-
" pate that Malignity we have given way to by the
" oppoſite Conduct, to the Deſtruction of both Peo-
" ple, and the Ruin of the Trade. And if the
" ſame pacific Meaſures were taken alſo on the

" Weſtern

" Weſtern Coaſt, Southward of *Whale-cove*, for " the Protection and Encouragement of thoſe *Eſki-* " *maux* who lie ſcattered thereabout, the Foundati- " on of a moſt extenſive Fiſhery would be effectually " laid.

" Theſe laſt *Eſkimaux* ſubſiſt in Winter upon the " Stock they raiſe in Summer, which is ſuppoſed to " be Oil, Blubber, and the like; and yet the Sea- " ſon of the Whale-Fiſhery there ſeldom laſts above " nine Weeks; in which time they muſt kill a pro- " digious Quantity to be able not only to lay up a " Store for a long Winter, but to make a Reſerve of " Tuns of Oil for the Company's annual Sloop: " And if this poor People can in their one Man " Canoes, with ſuch Tackling as their little Skill " enables them to make of Ivory, Wood and Lea- " ther, kill ſo many Whales in ſo ſhort a Time, and " in ſo ſmall a Part of the Bay, there is no fixing " Bounds to the Proportion, if a Fiſhery was carri- " ed on at the Rivers, under proper Directions and " Encouragement, and the Natives furniſhed with " Harpoons, Nets, Hooks, and other Tackling " made in England; and prompted beſides to exact " their utmoſt Art and Induſtry, by a kind and ge- " nerous Treatment.

" The Circumference of the Bay is at leaſt 2500 " Miles, with ſo many Rivers and Inlets all round, " that a conſiderable River or Inlett may be allowed " to every hundred Miles. In the Rivers where " I reſided, as much Oil, &c. might be procured, " as would be ſufficient to load 150 Tons of Ship- " ping annually; conſequently by the ſame Com- " putation, the whole Bay would employ 1250 " Tons; and in a ſhort time I dare ſay, many Hun- " dreds more; but the firſt Attempt muſt be made " by thoſe who are poſſeſſed of Judgement, Spirit,

" and

" and Integrity, or no plan however excellent,
" would inſure Succeſs.

" It ſhould be objected, that ſince the weſterly
" Rivers in the Bay are not clear of Ice till the Begin-
" ning of *June*, and the Fiſhery is over by the mid-
" dle of *Auguſt*, the Seaſon would laſt only ten
" Weeks, which would be too ſhort to kill Whales
" enough to defray the Expence: I anſwer firſt,
" that the Fiſheries of *Greenland* and *Davis*'s
" Streights do not laſt longer; and ſecondly, that
" the Expence in a great Meaſure might be ſaved,
" if as the Bay Fiſhery does not begin till the
" *Davis*'s Fiſhery is over, the ſame Ships were em-
" ployed in both. It is to be further objected,
" that Ships cannot get into the Bay by the Begin-
" ning of *June*, and therefore a great Expence
" would be incurred by ſo many *Engliſh* being
" obliged to winter there. I anſwer farther, that
" few *Engliſhmen* need be kept in the Bay, ſince the
" Natives may be hired upon very reaſonable terms,
" to attend the whole Time of the Fiſhery. The
" home *Indians* even now kill Geeſe for the Com-
" pany for very low Wages, and a much greater
" Number offer themſelves for this Service than
" can be employed, and the Seaſon of killing Geeſe
" is generally over a Week before the Fiſhery Sea-
" ſon comes on: Indeed theſe home *Indians* are ten-
" der, dull and inactive, but they need only be em-
" ployed in the Fiſhery whilſt in its infant State; for
" upon making Peace between them and the *Eſqui-*
" *maux*, thoſe native Fiſhers would carry on the
" Buſineſs alone, without any aſſiſtance from the
" home *Indians*, or even from the *Engliſh*, who
" need only act as Superviſors; but ſhould it be at
" laſt objected, that the Company long before this
" would have ſet ſuch a Fiſhery on foot, if it was

" near ſo beneficial as is now repreſented; the An-
" ſwer may be eaſily drawn from their while Con-
" duct for many Years paſt." As I was ſix Years in *Hudſon*'s Bay, I am acquainted with their Policy and Manner of Acting there, and the Reaſons why the Company have not made any conſiderable Progreſs in the Fiſheries and other Improvements.

Before I diſmiſs this Head, it may be proper to give it as my Opinion, that Methods may be taken, whereby ſix or ſeven Men cannot fail (if they uſe their utmoſt Endeavours) to kill as many Whales in a Week, as will yield ſeven Tons of Oil, and perhaps a great deal more; and if an Act could be obtained to ſettle a Colony in the ſouthern Parts of the Bay, in order to carry on the Fiſhery or other Trade, and make Diſcoveries that the Company doth not look after; and if a paoper Number of Merchants or Gentlemen, form themſelves into a Company for that Purpoſe, I will not only be glad to forward the Affair with all the Information I can give; but to prove I have the greateſt Hopes of Succeſs, I will ſubſcribe above one Hundred Pound out of my ſmall Fortune.

Of a Copper Mine near Hudſon's Bay.

In the Courſe of carrying on the Fiſhery and other Affairs, perhaps better Information may be got, for this Copper Mine for the Space of forty or fifty Years laſt paſt, has been much talked of in the Bay; and thoſe who underſtand the Country Language beſt, have long ago been throughly convinced of the Exiſtence of this Mine, and alſo of the Practicability of getting at it. I have ſeen of the Copper (that the *Indians* ſaid that they brought from the Mine) about the *Indians* Wriſts for Ornament, and alſo ſome Pieces, ſome of which I brought to *England*;

land; and in the Year 1718, when the Company firſt ſettled a Factory at *Churchill* River, and before the northern *Indians* had any Iron Utenſils from the *Engliſh*, ſome *Indians* that came from the Northward (called Copper *Indians)* had Ice Chiſels and other Things of Copper, which the *Indians* ſaid they got at the Side of the Sea, a Creek or Streight; and theſe Accounts have not been contradicted, at leaſt not as I have heard of. See my Account of *Hudſon*'s Bay, Page 69.

As I do not believe every Thing I hear as true, ſo I do not wholly rely upon every Information I have had by the Linguiſts; for in the firſt Place, the *Indians* Accounts are not always to be depended on as true, for when they find you are ſo pleaſed with their Story, as to give them ſomething, and deſire they will inform themſelves better, and give you an Account the next Time they come; whether they get any better Information or not, they'll prepare a Tale they think will pleaſe you: And in the ſecond Place, the Linguiſts in the Bay are not ſo underſtanding in the *Indian* Languages, eſpecially the northern *Indians* Language, as to be able to croſs examine them, and conſequently may not rightly underſtand the Meaning of every Word the *Indian* ſpeaks; and alſo the Linguiſt thinking thereby to pleaſe his Superior, may be ſuſpected of ſaying at one Time or other more in favour of a Diſcovery, than he has ſufficient Grounds or Authority from the *Indians* for.

After giving proper Allowances for the falſe Accounts, and the Difficulty of coming at the Truth as abovementioned, I am, from many corroborating Accounts, as well aſſured there is a Copper Mine at the Place the *Indians* ſpeak of, as I am aſſured of the being a Place called *Siberia* in *Ruſſia*, or the being

of any other Place I have not ſeen. That *Engliſhmen* may go to this Mine is evident by the *Indians* bein g able to go to it, who have their ſubſiſtance to procure Day by Day upon the Spot, which need not be the Caſe of the *Engliſhmen*; and if it is not a tolerable Place, and ſomething to be got there to ſubſiſt on, I think the *Indians* would not go there: But if they go to this Mine only for the Sake of getting Copper to make Ornaments for their Wriſts, *&c.* when they can have the ſame Sort of Ornaments (and more beautiful) for a Trifle at the *Engliſh* Factory, where they alſo viſit every Year; and as the *Indians* are more ſparing of Labour than *Engliſhmen* are, it is not unreaſonable to conclude, that the *Indians* would not go to the Copper Mine if it is far out of their Hunting Grounds, and in a deſolate Country; nor will they take much Trouble to procure what they can procure readily with little Trouble, from all which I think it is not unnatural to infer that the Copper Mine is in or near the *Indians* Hunting Ground: And as it is found by Experience, that *Engliſhmen* can travel in thoſe Countries as well as the *Indians*, there cannot be in the diſcovering this Mine any Difficulty equal to the Importance of the Diſcovery.

Of the North-Weſt Paſſage.

In order to diſcover the Exiſtence and Situation of the North-Weſt Paſſage (ſuppoſed to be from *Hudſon*'s Bay to the *Pacific Ocean* and *South Sea*) I would build five Boats with Bend-leather in the Place of Plank, light and well conſtructed for Defence againſt the *Eſkimaux*, and ſeven Men in each Boat, each Man armed with a ſhort Gun, Piſtols and Sword, each Boat to have two Swivel Blunderbuſſes; two of theſe Boats ought to ſail from the Bottom of

the

the Bay, and three from *Churchill* as ſoon as there is any Probability of a Paſſage along Shore, between the Shore and the Ice; one of the Boats from the Bottom of the Bay, to lye at Anchor in the Mouth of *Hudſon*'s Streights, the other in about ſixty-five on the eaſt Coaſt; one of the Boats from *Churchill* to anchor near the weſt Shore in about 62, another to anchor near *Cape Fry* in 64. 40. and the third to proceed to 67 or 68, if not obſtructed by the Ice, or as far to the Northward as poſſible, without too great a Riſque. The Boats that do not proceed ſo far to cruiſe about, and make what Diſcoveries they can till they ſuppoſe the northermoſt Boat has got to her Station; every Boat muſt obſerve the Winds, and be very exact as to the Time of Flood, the Direction and Strength of the Stream, both Flood and Ebb, the Time of High Water, and the Heighth it flows in Feet and Inches, *&c.* and at what Time of the Flood and Ebb the Stream runs ſtrongeſt, *&c.*

Caution and Direction.

The Boats to lye as clear from Iſlands as poſſible, that they may not lye in a counter Stream; one Half the Crew watch at a Time in the Night, and two in the Day, and keep a good Look out; ſuffer no *Eſkimaux* upon any Pretence to board your Boat; look with your Glaſs very often all round, eſpecially upon the Land, to ſee if you can diſcover any living Creature: This may prevent your being ſurpriſed by the *Eskimaux*; keep your Firearms clean, loaded and ready, try to catch Fiſh, *&c.*

Set up a Pole marked with Feet and Inches at the loweſt Low-water Mark, to ſhew when it is Low-water, when Flood, when High-water, and the Time the Water keeps up at its Heighth, and whether

ereth is a ſudden Riſe of the Water when young Flood, or when near High-water, or if there are two High-waters; that is, whether the Water riſe a ſecond Time in three Quarters of an Hour, or one Hour and an Half after the Tide has been at its Highth and Ebb for a conſiderable Time. About Half an Hour or an Hour before Low-water, put your Boat near the Shore that you may plainly ſee the Water riſe or fall upon the Shore and Pole; when you plainly perceive the Water riſe, allow ſix or eight Minutes out of the Time the Water neither fell or roſe, for its Beginning to riſe before you could be ſure that the Flood made it riſe; then put off to your Station, and obſerve the Stream till about one Hour before High-water, when put your Boat near the Pole again, to obſerve the Riſing of the Flood and Time of High-water, *&c.*

A Leather Boat of about four Feet and a Half long may be made, to have a Bag of Leather at her Bottom, to take up through the Bottom into the Boat or let down thro' the Bottom, and filled with ſmall Stones or Sand ſo as the the Weight of a Man cannot overſet her: This Boat will ſerve to go near the Shore, and obſerve by the Pole the Riſe and Fall of the Water; if you are diſturbed by the *Eskimaux*, remove twenty or thirty Miles either Way you chuſe along Shore, only know the Latitude you make your Remarks in.

The Scheme is the more practicable, as there is little or no Night in the Latitudes the Boats are to lye in all the Time the Boats need be upon this Service, and the Ice in the Bay prevents there being any Sea, let the Wind blow ever ſo ſtrong.

The above Remarks being made by the Boats at their ſeveral Stations upon one and the ſame Day, and upon one and the ſame Tide, there can be no doubt of being directed to the right Place where you

you cannot miſs of further Information, and if the Paſſage is practicable, you cannot fail of finding it.

I think my giving any Directions how to make uſe of the above Remarks cannot be neceſſary, as every expert Seaman is better able to form a proper Judgment of ſuch Affair.

As I have worte much concerning the Trade of and Diſcoveries in *Hudſon*'s Bay, and in 1752 publiſhed a Book in which are many Facts that reflect no Honour on the *Hudſon*'s Bay Company; ſome may think I write out of Rancour, Envy, or Revenge; therefore, to obviate Cenſure, I think it proper to declare, that if I were convinced of the *Hudſon*'s Bay Company uſing their utmoſt Endeavours to obtain all the Trade that is to be had in the Bay, Streights, *&c.* I would explain the Methods by which I think much more Trade may be obtained to the *Hudſon*'s Bay Company, with as muſt Pleaſure as I would to any other Set of Gentlemen, for I want no Profit out of *Hudſon*'s Bay, and it will be equal to me who increaſe the Trade and employ our Seamen, ſo it is but done to the utmoſt Extent.

An Abſtract of an Account of the Captivity of the Wife and Children of JOHN HANSON.

ON the 27th of the ſixth Month called *Auguſt*, 1725, my Huſband and all our Men Servants being abroad, eleven *Indians* armed with Tomahawks and Guns, who had ſome Time before been ſkulking about the Field, and watching an Opportunity of our Mens Abſence, came furiouſly into the Houſe. No ſooner were they entered, than they murdered one of my Childern on the Spot, intending no doubt by this Act of Cruelty, to ſtrike the greater Degree of Terror into the Minds of us who ſurvived; after they had thus done, their Captain came towards me with all the Appearance of Rage and Fury it is poſſible to imagine, nevertheleſs upon my earneſt Requeſt for Quarter, I prevailed with him to grant it.

I had with me a Servant Maid and ſix Children, but two of my little ones were at that Time playing in the Orchard; my youngeſt Child was but fourteen Days old, and myſelf of Coneſequence in a poor weak Condition, and very unfit to endure the Hardſhips I afterwards meet with, as by the Sequel will appear.

The next Step they took was to rifle the Houſe, which they did with much Hurry and Precipitation, being apprehenſive in all Probability of a Surpriſe; and as it was late in the Afternoon, they packed up what Linen, Woollen, and other Things they liked, and forthwith turned us out of the Houſe.

Being

Being now at the Door, my two Children who had been playing in the Orchard (the one ſix and the other four Years of Age) came in Sight, and being terrified at the Appearance of the naked *Indians*, they cried aloud, on which one of the *Indians* ran up to them, and taking one under each Arm brought them to us; my Maid prevailed with the biggeſt to be ſtill, but the other would not be pacified by any Means, but ſhrieking and crying very much; whereupon to eaſe themſelves of the Noiſe, and prevent the Danger of a Diſcovery that might ariſe from it, they made no more to do but knocked out its Brains before my Face.

The *Indians* having now killed two of my Children, the next Thing they did was to Scalp them, a Practice common with them whenever they kill any *Engliſh* People; this they do by cutting off the Skin from the Crown of the Head, which they take with them as an Evidence of the Number they have ſlain; and it has been currently reported, that the *French* in their Wars with the *Engliſh*, have given the *Indians* a pecuniary Reward for every Scalp they brought to them.

This being done, they prepared to leave the Houſe in great haſte, without committing any other Violence than taking what they had packed up, together with myſelf and little Babe fourteen Days old, my little Boy of ſix Years, one Daughter about Sixteen, another about Forteen, and my Maid Servant.

It was, as I ſaid before, but fourteen Days ſince my Lying-in, and being very tender and weakly, and turned out from my warm Room with every Thing ſuitable to my Circumſtances, it increaſed the Severity of the Hardſhips I underwent exceedingly; nevertheleſs I found the Caſe was ſuch, that I muſt either go or die, for I could make no Reſiſtance neither would any Perſuaſions avail.

Accordingly

Accordingly we began our Journey, each having ſome of the Plunder to carry, and I my Infant: the other three were now able to travel alone. But my new Maſter, the *Indian* Captain, was ſometimes humane enough to carry my Babe in his Arms; which I looked upon as a ſingular Favour, becauſe he had beſides a vrey heavy Burden, and conſiderably more than he could take up without the Help of his Men.

We paſſed through ſeveral Swamps and Brooks, carefully avoiding all beaten Paths, and every Track that looked like a Road, leſt we ſhould be ſurprized by our Footſteps.

We travelled that Night, I ſuppoſe, near ten Miles, in a direct Line, and then we halted. The *Indians* kindled a Fire, and we took up our Quarters by it. They took it in Turn to reſt themſelves, while a Party of them kept Watch, in Order to prevent a Surprize.

Thus did we travel for twenty-ſix Days ſucceſſively, and, in general, very hard; though ſometimes we were helped a little, by Water, over Lakes and Ponds.

Next to the Difficulty of croſſing the Rivers, were the prodigious Swamps and Thickets, which were very hard to paſs through. But here alſo my Maſter would ſometimes lend me his Hand; and, as they paſſed through quickly, one after another, it became pretty tolerable for the hindmoſt. But the greateſt Difficulty of all, and which deſerves firſt to be named, was our Want of proper Suſtenance: for we were now reduced to very great Extremity; having often nothing to eat but Pieces of old Beaver-ſkin Watch-coats, which the *Indians*, in their Journey to our Settlement, had concealed, (for they came to us naked, as I ſaid before) but now, in their Return, took along with them. They were uſed more for Food than Raiment; being cut out in long, narrow

row Straps, of which they gave us ſome little Pieces. Theſe, after their Example, we laid upon the Fire till the Fur was ſinged off, and then ate them as dainty Morſels; experimentally knowing, that, to the Hungrey every bitter Thing is ſweet.

Of this Diet, mean as it was, we had but a ſcanty Allowance. And, what ſtill further increaſed my Affliction, was, the Complaints and Moans of my poor Children. Sometimes indeed the *Indians* caught a Squirrel, or a Beaver; at others, we met with Nuts, Berries, and Roots; and ſometimes we ate the Bark of Trees; but had no Corn for a long while, till a Party of the younger *Indians* went back, and brought ſome from the *Engliſh* Inhabitants, of which they gave us a very ſhort Allowance. But, when they killed a Beaver, we lived high while it laſted; as their Cuſtom was to allow me the Guts and Garbage for myſelf and Children; but they would by no means ſuffer us to waſh and cleanſe them; which occaſioned this Kind of Diet to be very loathſome: and indeed nothing but pining Hunger would have made it in the leaſt Degree tolerable.

When we were pretty far advanced in our Journey, the *Indians* divided; and, to our great Sorrow, divided us amongſt them. My eldeſt Daughter was taken away firſt; and carried to another Part, far diſtant from us; and we had not travelled far, before they parted again, and took from me my ſecond Daughter, and my Servant Maid; ſo that I had only the Babe at my Breaſt, and my little Boy of ſix Years old; we three remained with the Captain: but my Daughter and Servant underwent very great Sufferings after they were taken from us; travelling very hard for three Days together, without any Suſtenance but cold Water, and, on the third Day, the Servant fell down in a Swoon, as dead; at which the *Indians* ſeemed ſurprized, and began to ſhow ſome

Signs

Signs of Tenderneſs, not being willing to loſe any of their Captives by Death, after they had brought them ſo near their own Home; hoping, no Doubt, in Caſe they lived, to obtain a conſiderable Price for their Ranſom. Accordingly, in a few Days after this, they drew near their Journey's End, where they found greater Plenty of Corn, and other Food; but Fleſh often fell very ſhort, as they had no other Way of procuring it but Hunting.

It was not long before my Daughter and Servant were parted alſo; and my Daughter's Maſter falling ſick, he was thereon diſabled from hunting. All their Corn was likewiſe ſpent; and ſo great were their Diſtreſſes, that they were compelled to feed upon the Bark of Trees for a whole Week, being almoſt famiſhed to Death.

At Length we arrived at the *Indian* Fort, where many of the People came to viſit my Maſter, and his Family, and congratulate him on his ſafe Return, and the Succeſs of his Expedition. Public Rejoicings were made upon it (which, in their Way, perhaps were a Kind of Thankſgiving); and theſe were attended with Dancing, Firing of Guns, Beating on hollow Trees, inſtead of Drums, Shouting, Drinking, and Feaſting for ſeveral Days, together with much Exceſs.

We had not long been arrived before my Maſter went abroad to hunt for Proviſions for the Family, and was abſent about a Week. Before he ſet out, he ordered me to procure Wood, and gather Nuts; In doing which I was very diligent, during the Time of his Abſence, in cutting the Wood, and putting it up in Order. But no ſooner was he returned, than I quickly perceived he was very much diſpleaſed; for he had met with no Succeſs in his hunting Expedition; and ſo ſtrongly did his Diſappointment work upon him, that he began to revenge it on us his

Captives.

Captives. He allowed me however a little boiled Corn for myſelf and Child; but looking upon us with a very angry Countenance, he threw a Stick at me, with ſuch Violence as plainly demonſtrated, that he grudged us the Food we had received from him.

The poor old Squaw, his Mother-in-law, was very kind and tender to me, and, all that Night, would not leave me; but came and laid down at my Feet, ſignifying her Intention to uſe her Endeavours to appeaſe his Wrath. For my own Part, I got but little Reſt that Night; though my Babe ſlept ſweetly by my Side: but I dreaded the tragical Deſign of my Maſter, and looked every Hour when he would enter the Wigwam, to execute his bloody Purpoſe. But here again kind Providence interpoſed. For, being weary with hunting, and having toiled in the Woods without Succeſs, he went to Reſt, and forgot to put in Ptactice the horrid Purpoſe he had formed.

When Fleſh was ſcarce, we were only allowed the Guts and Garbage; but were not permitted to cleanſe them any other Way than juſt by emptying the Dung out of them, and afterwards boiling them together with the Broth of Fowls; which would have been extremely nauſeous, had not Hunger compelled us to eat; but in Time this Kind of Food, which often fell to our Lot, became pretty tolerable to a keen Appetite; though, at another Time, I could by no Means have diſpenſed with it. And this led me to conſider, that none are able to ſay what Hardſhips they can ſuffer till the Trial comes upon them For that, which in Time paſt I had thought not fit for Food in my own Family, I ſhould now have eſteemed a ſweet Morſel, and a dainty Diſh.

By this Time I was reduced ſo low, through Fatigue of Spirits, hard Labour, mean Diet, and the frequent

frequent Want of natural Reſt; that my Milk was intirely dried up again, and my helpleſs Babe very poor and weak, appearing to be little more than Skin and Bones; for I could perceive every Joint of it, from one End of its Back to the other; and how to procure any Thing that might ſuit its weak Appetite, I was at a very great Loſs. Whereupon one of the *Indian* Squaws, perceiving my Uneaſineſs, began Diſcourſe with me, and withal adviſed me to take the Kernels of Walnuts, and after I had cleanſed them, to beat them up with a little Water, which accordingly I did, and the Water looked like Milk; then ſhe bade me add to this Water a little of the fineſt *Indian* Corn-meal, and juſt boil it up together: I did ſo, and found it very palatable; and ſoon perceived that it nouriſhed my Babe, for it quickly began to thrive, and look well; which gave me great Comfort. I afterwards underſtood, that with this Kind of Diet the *Indian* Children were often fed.

But the Comfort I received, on my dear Child's Recovery from the Brink of Death, was ſoon mixed with Bitterneſs and Trouble; for my Maſter, obſerving its thriving Condition, uſed often to look upon it, and ſay, that, when it was fat enough, he would have it killed and eaten. Purſuant to this Threat, he obliged me to fetch a Stick, which he ſaid he had prepared to roaſt my Babe upon. And, as ſoon as I had brought it, he made me ſit down by him, and undreſs the Infant. The Child now being naked, he began to feel its Arms, Legs, and Thighs; and having paſſed this Examination upon it, he informed me, as it was not yet fat enough, I muſt dreſs it again till it was in better Caſe. But, notwithſtanding he thus acted, I could not perſuade myſelf he was in earneſt, but that he did it with a View to afflict and aggravate me: neither could I think but that our Lives would be preſerved from his

his barbarous Hands, by the over-ruling Power of him, in whoſe Providence I put my Truſt both Night and Day.

A few Weeks after this, my Maſter made another Remove; which was the longeſt he ever made, being two Days Journey, and moſtly over the Ice. The firſt Day the Ice was bare; but ſome Snow falling on the Second, it made it very difficult to travel over. I received much Hurt by frequent Falls: having beſides the Care of my Infant, which increaſed my Trouble not a little. It was Night when we arrived at our Camp, and I was ordered to go and fetch Water; but having ſat a while on the cold Ground, I could neither ſtand nor go, by Reaſon that my Limbs were ſo benumbed with cold. Yet I dared not refuſe; and therefore attempted it by crawling on my Hands and Knees; but a young *Indian* Squaw, belonging to another Family, being come to ſee our People, ſhe, in Compaſſion, took the Kettle, and knowing where to go, which I did not, fetched the Water for me; which I took as a great Favour, in that her Heart was inclined to do me this Service.

I now ſaw the Deſign of this Journey. My Maſter, being weary of keeping us, was willing to make what Ranſom he could of us; and therefore went farther towards the *French* Settlements, leaving his Family at this Place; where they had a great Dance, ſeveral other *Indians* coming to our People. This held ſome Time; and, while they were employed in it, I got out of their Way, as far as I could, into a Corner of the Wigwam: But every Time they came by me in their Dancing, they would Bow my Head towards the Ground, and frequently kick me with great Fury. Divers of them were barefooted, and the reſt had only Mockſans on. The Dance laſted

ſome

ſome Time; and they made, in their Manner, great Rejoicing and Noiſe.

It was not many Days before my Maſter returned from the French; but, in ſuch an ill Humour, that he would not ſuffer me to abide in his Preſence. I had a little Shelter, made with Boughs; having firſt digged through the Snow, quite to the Ground. In this Hole I and my poor Children were put to lodge; and, as the Weather was then very ſharp, and the Froſts very hard (it being then the Month called *January*) our Lodging was extremely bad. But our Stay was not long in this wretched Place, before my Maſter took me and my Children to the *French*, in Order to get a Chapman for us: when we came among them, I was expoſed to Sale, and the Price my Maſter put upon me was 800 Livres. But, nobody appearing diſpoſed to comply with his Demands, and a Frenchman offering no more than 600 Livres, it threw him into ſuch a Rage that he ſaid in his Paſſion, if he could not have his Price he would burn me and the Babe in the View of the City of *Port Royal*. The Frenchman bade him make the Fire; and added, I will help you, if you think that will do you more good than 600 Livres; "calling him Fool, and roughly bidding him be gone:" but, at the ſame Time, he was very civil to me; and, for my Encouragement, bade me be of good cheer, for I ſhould be redeemed, and not go back with the *Indian* again. I was obliged however to retire with my Maſter that Night; but, the next Morning I was redeemed for 600 Livres.

In driving the Bargain with my Maſter, the Frenchman aſked him why he demanded ſo much for the little Babe's Ranſom; urging, that when it came to have its Belly full it would die. The *Indian* ſaid, No, it would not die; having already lived twenty-ſix Days on nothing but Water; and

that

that he believed it was a Devil. The Frenchman ſaid no, but the Child is ordered for longer Life; and it hath pleaſed God to preſerve it to Admiration. My Maſter anſwered, No, that was not the Caſe; but that it was a Devil, and he believed it would not die, unleſs they took a Hatchet and knocked out its Brains.

I had then been about five Months among the *Indians*, and one Month with the *French*, when my dear Huſband, to my unſpeakable Joy and Comfort, came to me. He was much concern'd for the Redemption of his Children; two of our Daughters, and the Servant-maid, being ſtill in the Hands of the *Indians*; and only myſelf and the two little ones redeemed.

Accordingly, after much Difficulty and Trouble, he recovered our younger Daughter, and the Maid; but we could by no Means obtain our eldeſt from them. For the Squaw to whom ſhe was given, had a Son; and ſhe intended a Match between my Daughter and him, hoping in Time to prevail upon her to comply: for the *Indians* are ſeldom guilty of any indecent Carriage towards their captive Women, unleſs much overtaken in Liquor. The Affection they had for my Daughter made them refuſe all Offers and Terms of Ranſom; ſo that, after my Huſband had waited, and uſed his utmoſt Endeavours to obtain our Child, we were obliged to depart homewards, and leave our Daughter, to our great Grief, amongſt the *Indians*.

We accordingly ſet forward over the Lake, with three of our Children and Servant, in Company with ſeveral others; and, by the Kindneſs of Providence, got well home, on the firſt of the ſeventh Month, called *September*, in the Year 1725, from which it appears, that I had been from home, amongſt the

Indians

Indians, and *French*, and upon my Journey, twelve Months and twenty-ſix Days.

But my dear Huſband could not enjoy himſelf with Satisfaction, our eldeſt Daughter being yet in the Hands of the *Indians*; he therefore began a Second Journey, about the 19th of the ſecond Month 1727, in Order to redeem her, in Company with a Kinſman and his Wife, who went to redeem ſome of their Children, and were ſucceſsful to their Deſire; but my dear Huſband died in the Woods, about half Way between *Albany* and *Canada*, in my Kinſman's Arms.

N. B. The Subſtance of the foregoing Account was taken from her own Mouth by *Samuel Bownas*. And, in the ſeventh Month, called *September*, 1741, *Samuel Hopwood* was with her, and received the Relation much to the ſame Purpoſe; at which Time he ſaw the Child (then grown a young Woman) who was ſucking at her Breaſt when ſhe was carried into Captivity.

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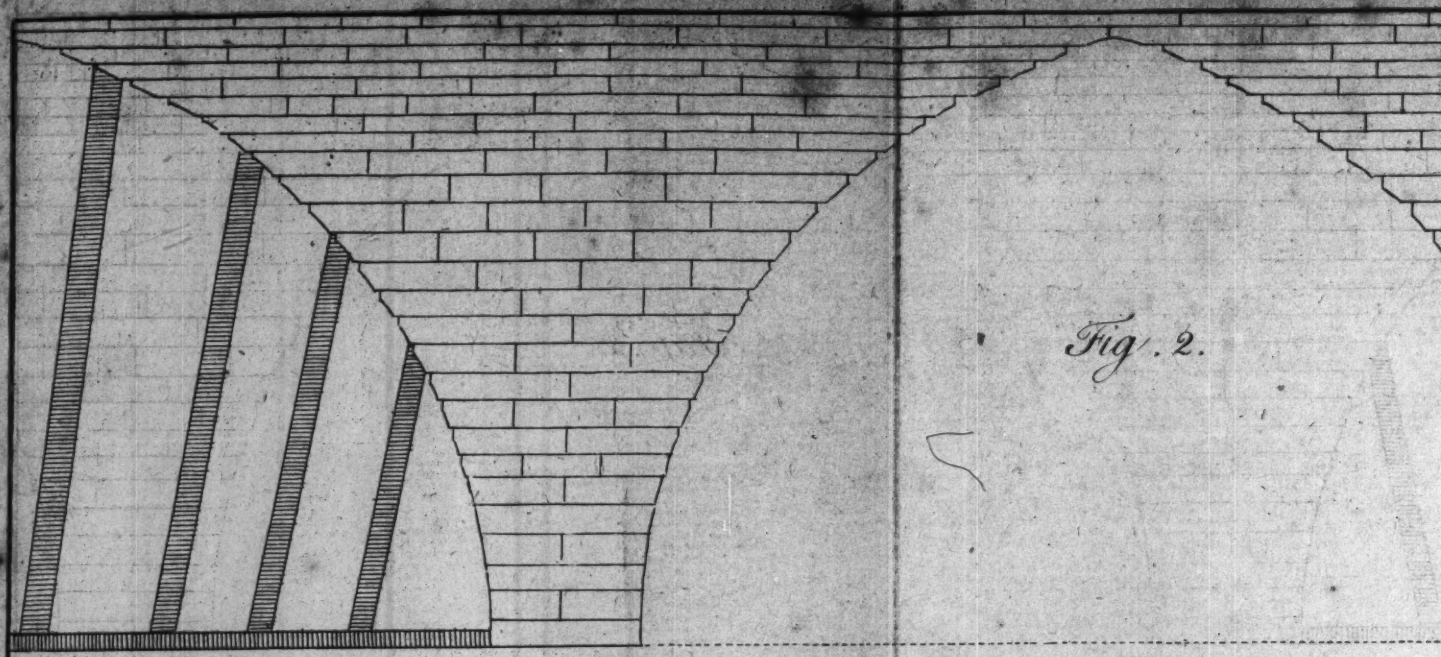
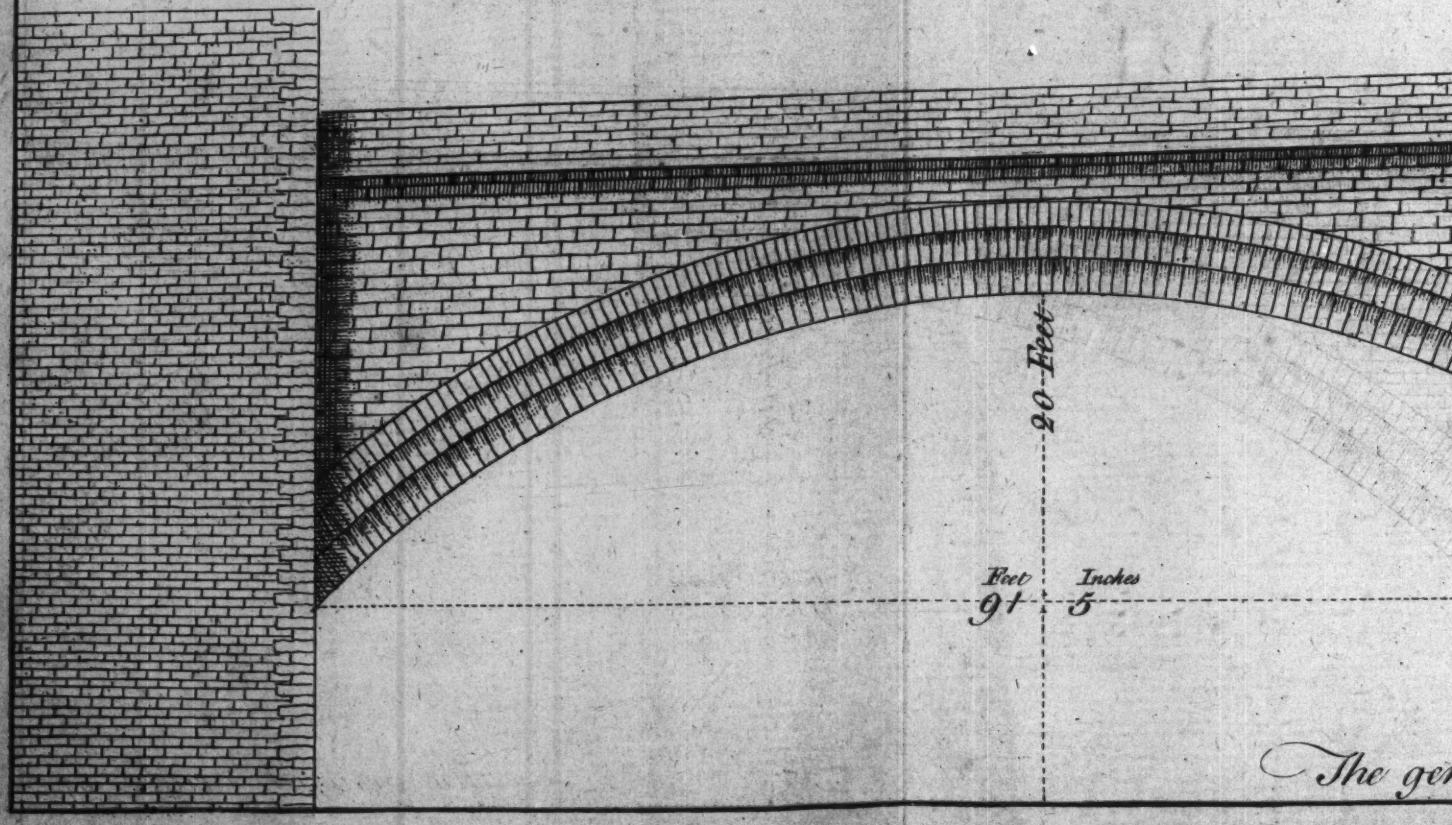


Fig. 2.

Fig. 2. To build Bridges without Cen



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Newton Bridge near Bishop Auckl

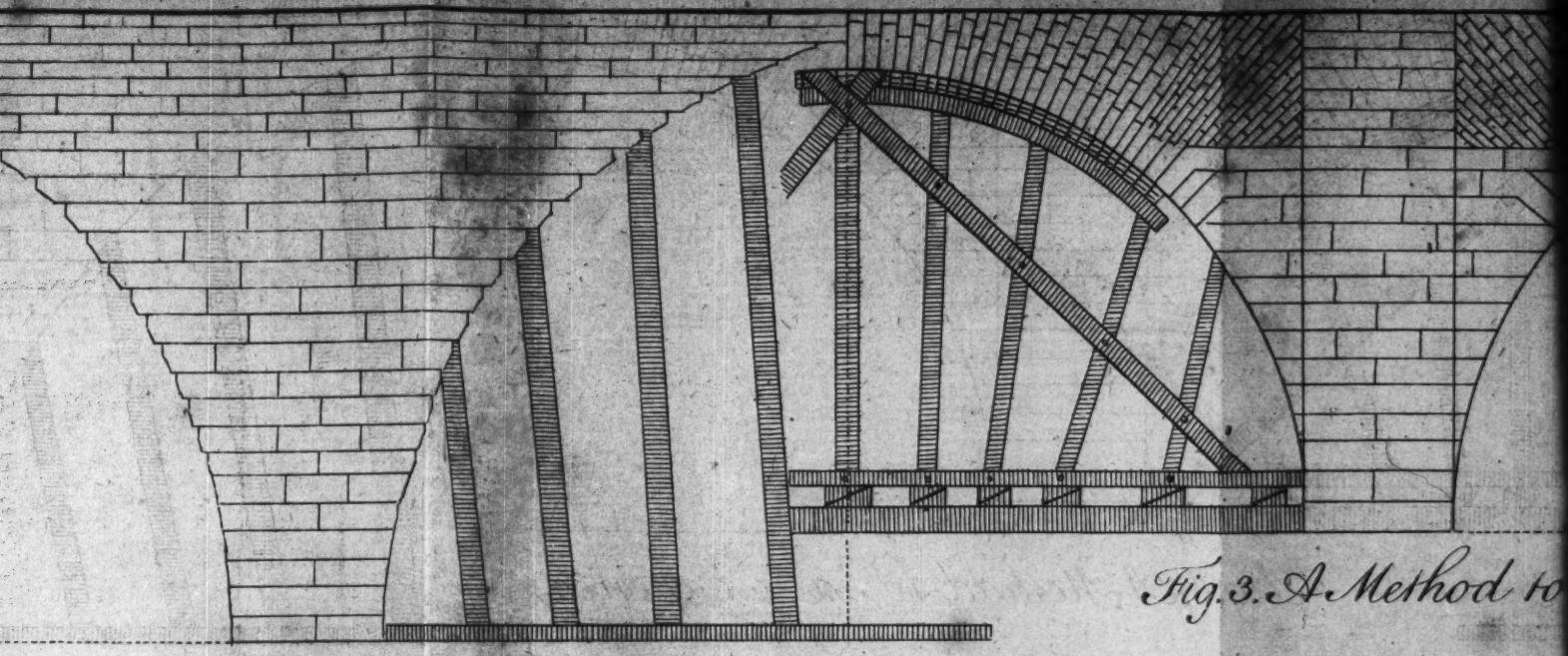
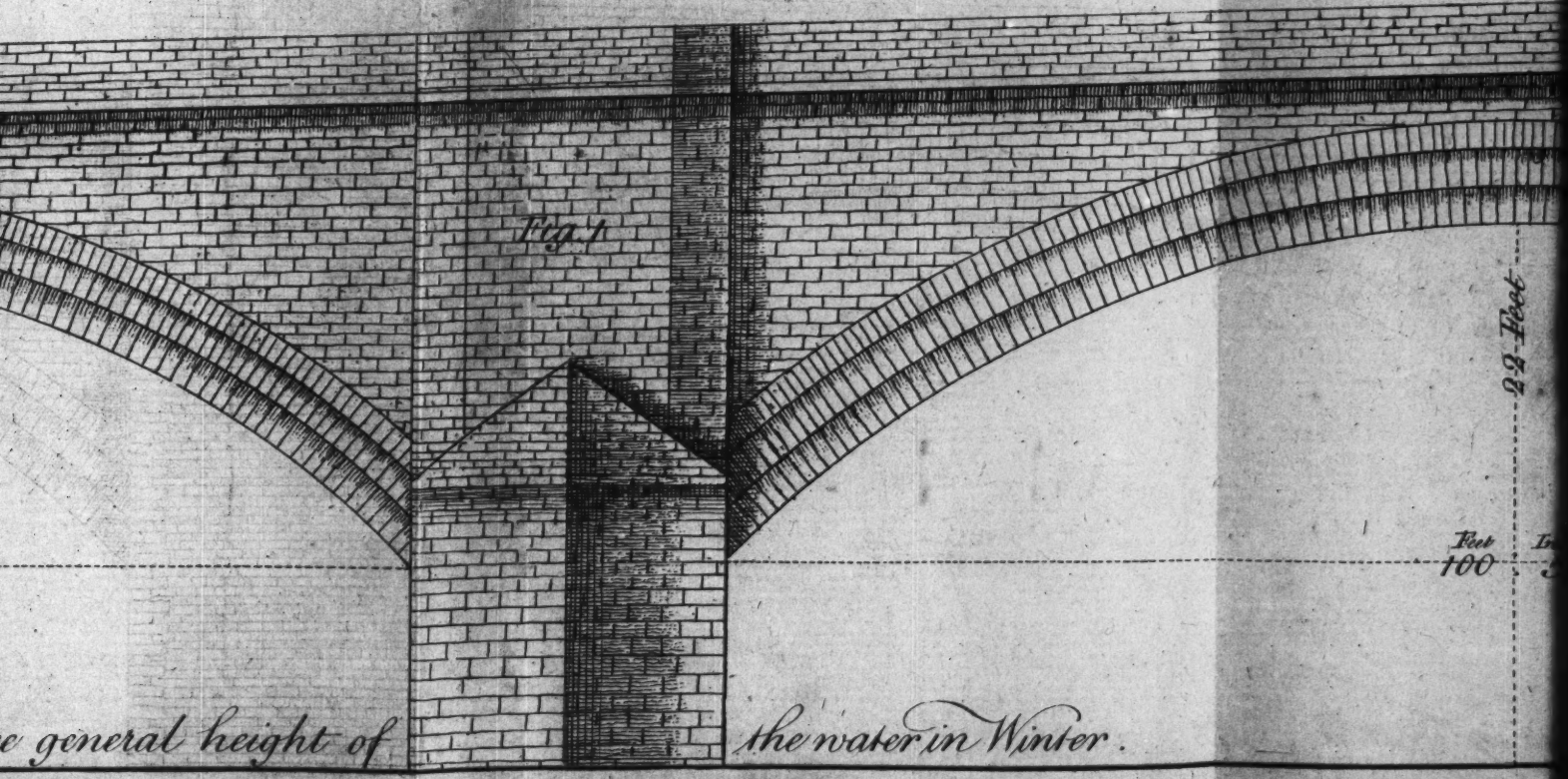


Fig. 3. A Method to

Centers.



e general height of the water in Winter.

uckland in the County of Durham; Scale 15 Feet in an Inch; Built by

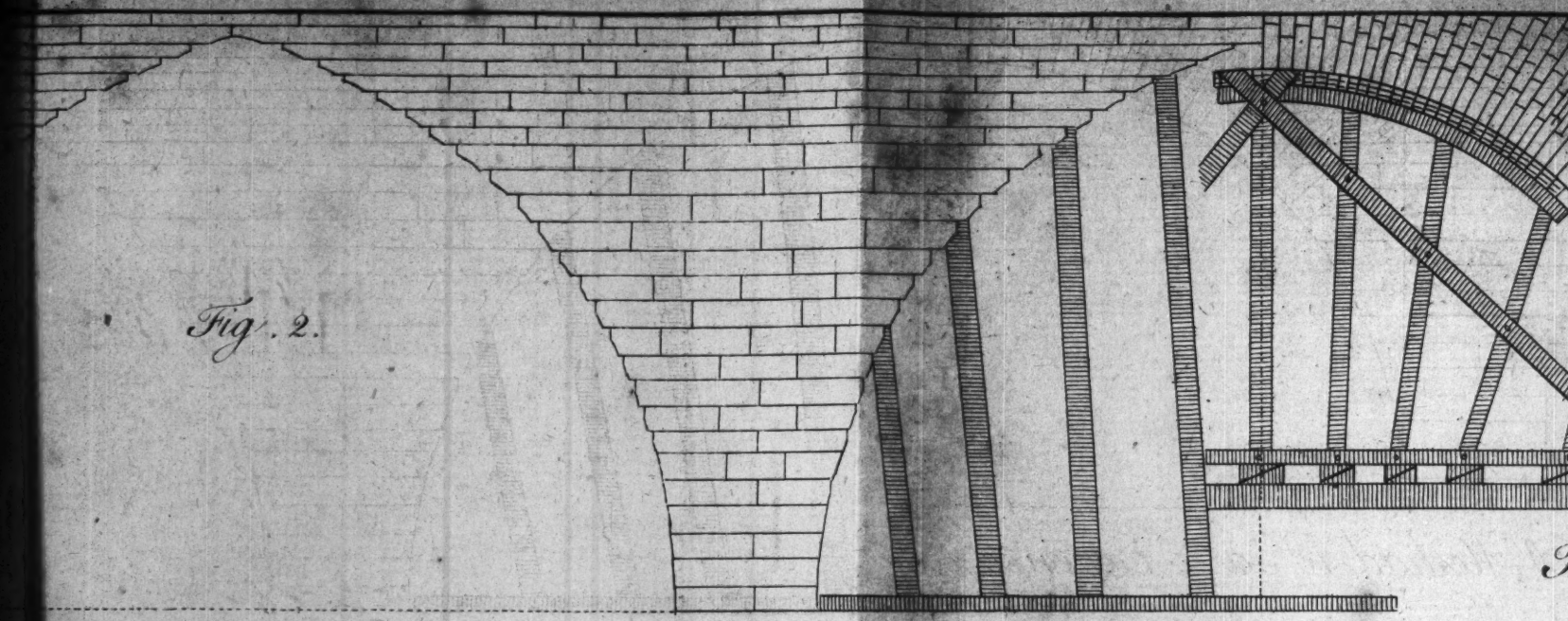
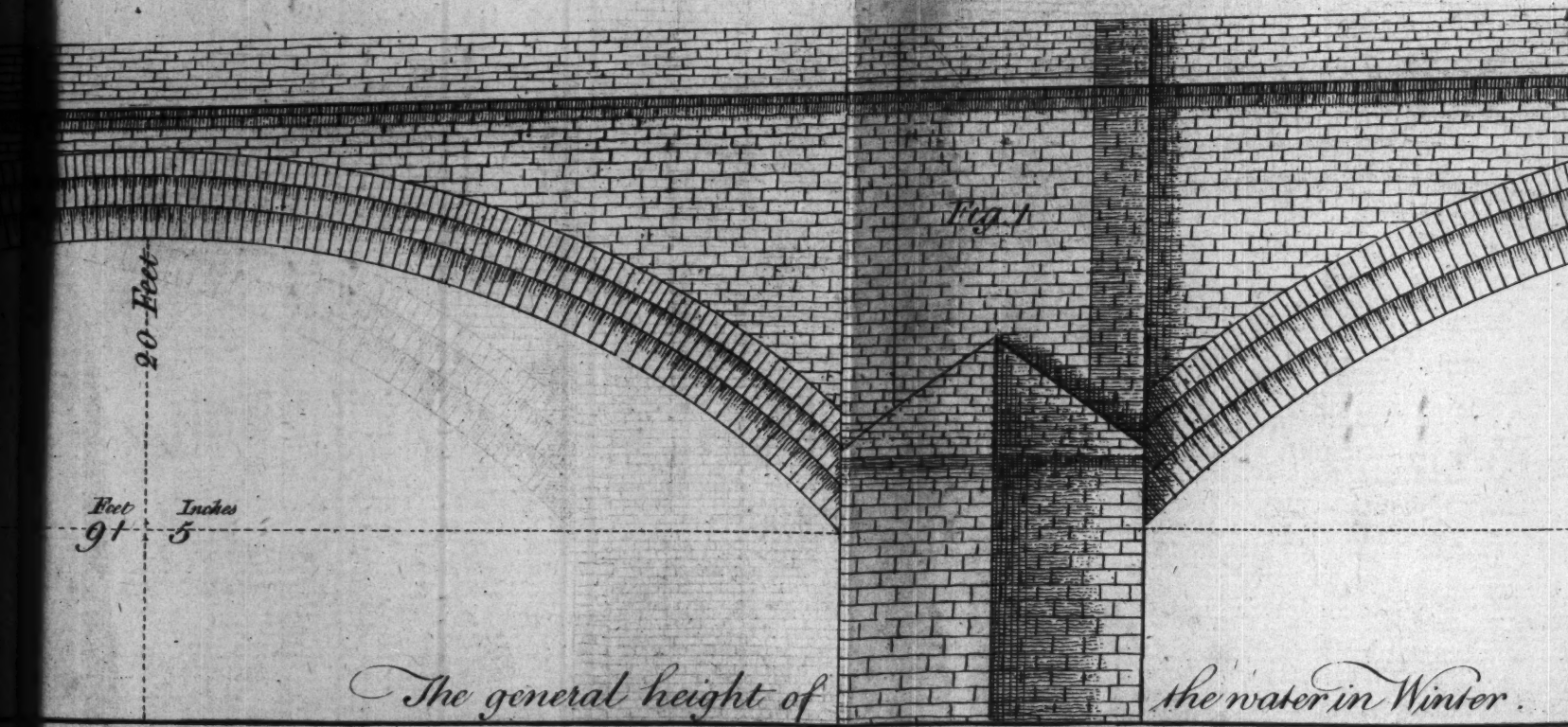


Fig. 2.

Bridges without Centers.



near Bishop Auckland in the County of Durham; Scale 15 Feet in an

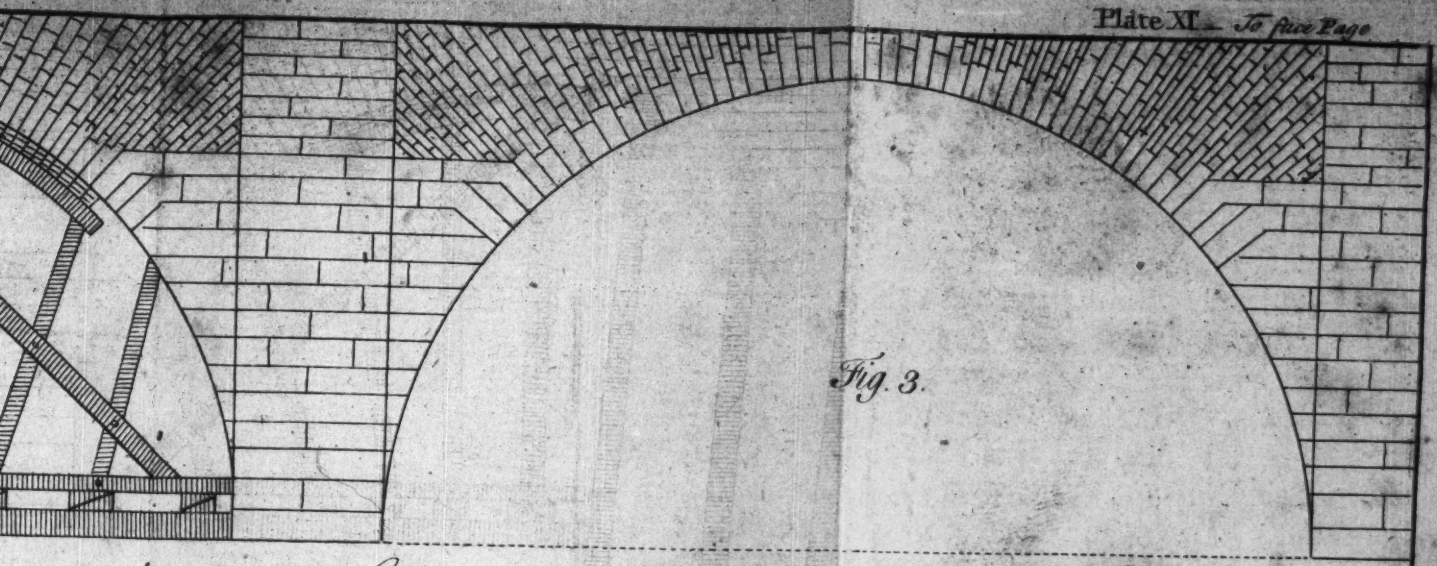
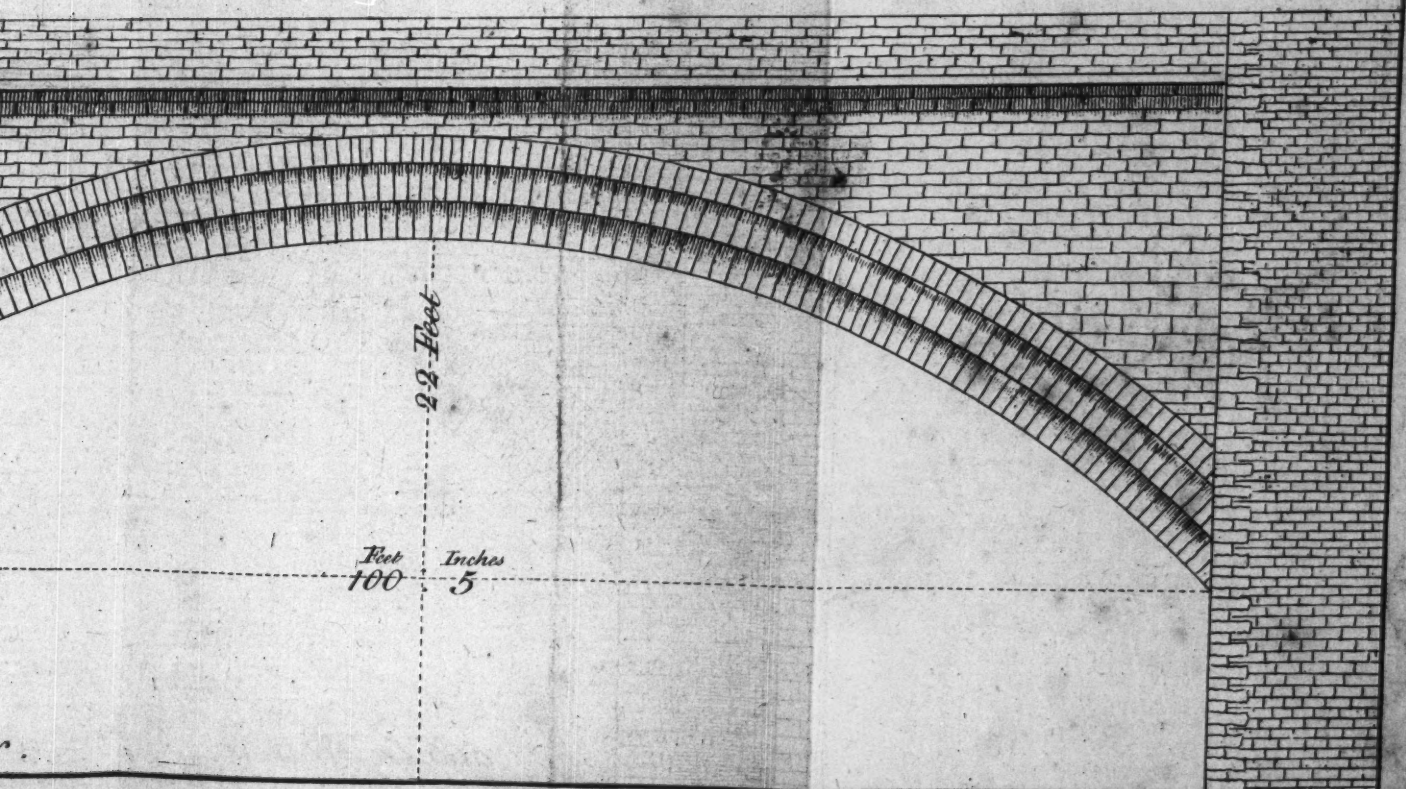


Fig. 3.

Fig. 3. A Method to save Expience in Centers.



an Inch: Built by Wilfre Shirley 1388.